Cyprus University of Technology

Faculty of Management and Economics

**Doctoral Dissertation**

# Empirical Essays on Stock Price Crash Risk

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**Limassol, March 2021**

CYPRUS UNIVERSITY OF TECHNOLOGY

FACULTY OF MANAGEMENT AND ECONOMICS

DEPARTMENT OF COMMERCE, FINANCE AND SHIPPING

Doctoral Dissertation

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# Approval Form

Doctoral Dissertation

## EMPIRICAL ESSAYS ON STOCK PRICE CRASH RISK

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# ΠΕΡΙΛΗΨΗ

Κατά την τελευταία δεκαετία, η βιβλιογραφία που εξετάζει τη σχέση μεταξύ της κατάρρευσης των τιμών των μετοχών και των καθοριστικών της παραγόντων, έχει εξελιχθεί ραγδαία. Η πιο διαδεδομένη εξήγηση που προτάθηκε από τη βιβλιογραφία μέχρι στιγμής προκύπτει από την θεωρία της αντιπροσώπευσης και αναγνωρίζει τον κεντρικό ρόλο των διαχειριστών στην εκμετάλλευση της ασύμμετρης πληροφόρησης για την απόκρυψη αρνητικών πληροφοριών από την επενδυτική κοινότητα.

Η βιβλιογραφία αντιλαμβάνεται την κατάρρευση της τιμής των μετοχών ως μια ακραία αρνητική τιμή στην κατανομή των αποδόσεων. Ωστόσο, αυτή η διατριβή φέρνει στο προσκήνιο μια έντονη αντίθεση μεταξύ του ορισμού της κατάρρευση της τιμής των μετοχών ως μία ακραία τιμή που θα έπρεπε να παρατηρείται σπάνια και των εμπειρικών πτώσεων που παρατηρούνται στην πραγματικότητα. Το πρώτο κεφάλαιο παρουσιάζει το «αίνιγμα» του κινδύνου της κατάρρευσης των τιμών, δείχνοντας μια σταθερά αυξανόμενη τάση στα περιστατικά κατάρρευσης τιμών. Συγκεκριμένα, η συχνότητα της απότομης πτώσης των τιμών των μετοχών αυξάνεται από 5,5% το 1950 σε 27% το 2018. Αυτό το κεφάλαιο προσφέρει εμπειρικά στοιχεία που υποδηλώνουν ότι τα δύο διακεκριμένα κανάλια που βασίζονται στη θεωρία της αντιπροσώπευσης και προτείνονται από τη βιβλιογραφία κατάρρευσης τιμών, δηλαδή την αδιαφάνεια των χρηματοοικονομικών αναφορών και την υπερβολική επένδυση, προσφέρουν περιορισμένο ρόλο στην επεξήγηση των ανοδικών τάσεων της πτώσης των τιμών των μετοχών. Επιπλέον, παρατηρείται ότι σημαντικές λειτουργίες εταιρικής διακυβέρνησης παρουσιάζουν αξιοσημείωτες βελτιώσεις. Η μελέτη διεξάγει συμπληρωματική ανάλυση που δείχνει ότι, ειδικά όταν χρησιμοποιείται το δείγμα μετά το Sarbanes Oxley Act (2002), υπάρχει απουσία στατιστικής σχέσης για οποιοδήποτε από τα κανάλια που βασίζονται στη θεωρία της αντιπροσώπευσης.

Το δεύτερο κεφάλαιο εστιάζει στα ευρήματα του πρώτου κεφαλαίου και στοχεύει στην εμβάθυνση των παρατηρούμενων ανοδικών τάσεων κατάρρευσης τιμών. Επανεξετάζει τον βασικό ρόλο των Διευθύνοντων Συμβούλων και τη σύνδεσή τους με τον μελλοντικό κίνδυνο πτώσης των τιμών των μετοχών, παρέχοντας εμπειρικά στοιχεία που υποδηλώνουν ένα κανάλι που υποστηρίζει αυτήν την σχέση. Συγκεκριμένα, συνθέτει την υπάρχουσα εμπειρική βιβλιογραφία για τις καταρρεύσεις των τιμών των μετοχών που εστιάζει στα χαρακτηριστικά και τα κίνητρα των Διευθύνοντων Συμβούλων. Η εμπειρική

ανάλυση παρέχει στοιχεία που υποδηλώνουν ότι, παρόλο που οι αλλαγές που επιβάλλονται στο ρυθμιστικό καθεστώς μετατρέπουν τις εταιρείες σε πιο διαφανείς και η χρηματοπιστωτική κρίση λειτούργησε ως εξωγενές πειθαρχικό σοκ στη διοίκηση για να αποφεύγεται η σπατάλη κεφαλαίων με υπερβολικές επενδύσεις, ορισμένα από τα διαχειριστικά χαρακτηριστικά και τα κίνητρα εξακολουθούν να συνίστανται μια εξήγηση για τα περιστατικά κατάρρευσης των τιμών. Ωστόσο, ενώ η σχέση Διευθύνοντων Συμβούλων-κατάρρευσης τιμών εξακολουθεί να είναι εμφανής και η επεξηγηματική ισχύς των καναλιών που βασίζονται στη θεωρία αντιπροσώπευσης έχει εξασθενήσει με το πέρασμα του χρόνου, οι διαχειριστές αναζητούν εναλλακτικά κανάλια για να διατηρήσουν ή/και να διογκώσουν τις προσδοκίες των επενδυτών και κατά συνέπεια το επίπεδο τιμών των μετοχών, τα οποία να μην τους καθιστούν νομικά υπόλογους. Η διατριβή αυτή προτείνει ένα νέο κανάλι, το διαχειριστικό ρητορικό κανάλι, το οποίο χρησιμοποιείται ως ζωτικός αγωγός μέσω του οποίου οι διαχειριστές μεταφέρουν πληροφορίες στην επενδυτική κοινότητα και διαμορφώνουν τις προσδοκίες των επενδυτών. Η διαχειριστική ρητορική σε εταιρικές αναφορές με θετικό ύφος και οι συζητήσεις σχετικά με δραστηριότητες τεχνολογίας και καινοτομίας συνδέονται θετικά με τον κίνδυνο πτώσης των τιμών των μετοχών.

Το τρίτο κεφάλαιο ερευνά τη διαχειριστική ευκαιριακή συμπεριφορά κατά τα έτη πριν από την αποχώρηση των Διευθύνοντων Συμβούλων. Τα ευρήματα δείχνουν ότι ο κίνδυνος πτώσης των τιμών των μετοχών είναι αυξανόμενος πριν από την αποχώρηση του Διευθύνοντος Συμβούλου. Συγκεκριμένα, ένα και δύο χρόνια πριν από την αποχώρηση του Διευθύνοντος Συμβούλου, παρατηρούνται 24,5% και 23,9% περισσότερες καταρρεύσεις τιμών συγκριτικά με τα υπόλοιπα χρόνια της θητείας του Διευθύνοντος Συμβούλου. Αυτό το φαινόμενο έχει αποδοθεί σε μια συμπεριφορά «λυκόφωτος», σύμφωνα με την οποία οι διευθύνοντες σύμβουλοι κατά τα τελευταία χρόνια παραμονής τους στην εταιρεία φαίνεται να ενεργούν ευκαιριακά κρύβοντας αρνητικά νέα από τους επενδυτές. Αυτή η συμπεριφορά έχει επιπτώσεις στον προσωπικό τους πλούτο, διότι, για παράδειγμα, οι διευθύνοντες σύμβουλοι φαίνεται να μειώνουν σημαντικά τα δικαιώματα προαίρεσης και την ιδιοκτησία τους σε μετοχικό κεφάλαιο, σε σύγκριση με τους Διευθύνοντες Συμβούλους που συνεχίζουν τη θητεία τους. Τέλος, αυτή η διατριβή διερευνά τις επιπτώσεις στο περιβάλλον εταιρικής διακυβέρνησης γύρω από τις αποχωρήσεις των Διευθύνοντων Συμβούλων.

# ABSTRACT

Over the last decade, the literature examining the relationship between stock price crashes and their determinants has been undergoing a substantial development. The most prevalent explanation proposed by the literature so far, arises from the conceptual apparatus of agency theory and acknowledges the central role of managers in exploiting information asymmetry to withhold negative information from the investment community.

The literature theorizes firm-specific stock price crash as an extreme negative value in the distribution of firm specific returns. However, this chapter brings to the fore a stark contrast between its definition as an outlier and the empirical occurrence of stock price crashes. The first chapter introduces the stock price crash risk puzzle by demonstrating a steadily growing trend on the stock price crash occurrences. Specifically, the incidence of firm-specific stock price crashes rises substantially from 5.5% in 1950 to 27% in 2018. This chapter offers empirical evidence suggesting that the two prominent agency-based channels proposed by crash literature, financial reporting opacity and overinvestment, offer a limited role in explaining the up-trending occurrences of stock price crashes. Furthermore, it is observed that important corporate governance functions exhibit noteworthy improvements. Finally, supplemental multivariate analysis conducted in this chapter, demonstrates that, especially when using the post SOX sample, there is a remarkable absence of any statistical relationship for either of the agency-based channels.

The second chapter draws motivation from the findings of the first chapter and strives to illuminate the observed up-trending occurrences of stock price crashes. This chapter revisits the key role of CEOs and its linkage with future firm-specific stock price crash risk by providing empirical evidence suggesting a channel underpinning this association. Specifically, it synthesizes the existing empirical stock price crash literature that focuses on managerial characteristics and incentives. The empirical analysis provides evidence suggesting that, although the changes imposed to the regulatory regime shift firms to more transparent disclosures, and financial crisis acted as exogenous disciplining shock on management to avoid squandering funds by overinvesting, some of the managerial characteristics and incentives can still consist an explanation for the stock price crash occurrences. However, while the CEO-crash relationship is still apparent, and the

explanatory power of the agency-based channels has attenuated as time wears on, managers are seeking for alternative channels to retain/inflate investor's expectations and subsequently the level of stock prices, to safeguard against potential legal jeopardy. This chapter proposes a new channel, the managerial rhetoric channel, which is employed as a vital conduit through which managers convey information to the investment community and shape investors' expectations. Managerial rhetoric in corporate reports featuring positive tone sentiment and discussions of technology and innovation activities is positively associated with one year ahead stock price crash risk.

The third chapter investigates managerial opportunistic behavior in the years prior to CEO departures. The findings show that the occurrence of a stock price crash is heightened prior to the departure of the CEO. Specifically, one and two years before the CEO departure, firms experience 24.5% and 23.9% more stock price crashes than the rest years of CEO tenure. This phenomenon has been ascribed to a "crepuscular behavior", whereby CEOs in their final years in office appear to act opportunistically by overly hiding negative news from investors. This behavior has certain wealth effects because, for instance, departing CEOs appear to significantly reduce their options and stock ownership, in comparison with their non-departing peers. Finally, this chapter investigates the corporate governance environment implications surrounding CEO departures.

**Keywords:**

stock price crashes; bad news hoarding; agency theory; stock price crash channels; corporate governance; managerial characteristics; managerial incentives; managerial rhetoric channel; managerial myopia; short-termism; CEO departure

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| | |
|---|---|
| Amex | American Stock Exchange |
| CEO | Chief Executive Officer |
| CFO | Chief Financial Officer |
| CRSP | Center for Research in Security Prices |
| CSR | Corporate Social Responsibility |
| IFRS | International Financial Reporting Standards |
| MD&A | Management's Discussion and Analysis of Financial Condition and Results of Operations |
| Nasdaq | National Association of Securities Dealers Automated Quotations |
| NYSE | New York Stock Exchange |
| OLS | Ordinary Least Square |
| Reg FD | Regulation Fair Disclosure |
| SEC | Securities and Exchange Commission |
| SIC | Standard Industry Classification Code |
| SOX | Sarbanes-Oxley Act |

# Chapter 1

## Stock price crash risk: A critique of the agency theory viewpoint

# 1 Introduction

The stock price crash literature has been undergoing a substantial development over the last decade, while the relationship between crashes and their determinants is a growing area of study. The extant literature defines a stock price crash as an extreme negative value, i.e. an outlier in the distribution of firm-specific returns (e.g. Chen, Hong, and Stein, 2001; Hong and Stein, 2003; Jin and Myers, 2006). In their seminal paper, Hutton, Marcus, and Tehranian (2009) theorize that a firm-specific stock price crash occurs if a firm experiences firm-specific weekly returns that fall more than 3.09 standard deviations below the mean firm-specific weekly returns within a fiscal year, with 3.09 chosen to generate a frequency of 0.1 percent in the normal distribution. Accordingly, if the firm-specific weekly returns were normally distributed, the probability of a stock price crash happening over the course of a fiscal year would then be $1-(1-0.001)^{52}$=0.0507, approximately 5%. Hutton, Marcus, and Tehranian (2009) specifically observed 17.1% of the firm-years in their sample experiencing one or more crash weeks. As the authors clarified, their intention was to choose a threshold that will represent a "reasonable benchmark for extreme events". By revisiting the crash frequency, in practice the observed percentage of stock price crashes for US stocks has grown from 5.5% in 1950 to almost 30% in 2018. The question that then naturally arises is *how is possible a figure such as 30% to represent an extreme event and why have we been observing a growth in stock price crashes as time wears on?*

Admittedly, there is a stark contrast between the empirical crash frequencies and definition of crash as an extreme event, that give birth to what is called in this chapter as the stock price crash puzzle. Specifically, the puzzle consists of two elements; first, on average there is a substantial difference between the empirical incidence of stock price crashes and the definition of crash as an outlier, and second, there is an increasing trend on the percentages of stock price crashes over time. The observed occurrences of stock price crashes have experienced a substantial intensification. The phenomenon exists across all US listed firms, using the expanded model to estimate the firm-specific returns and utilizing different data sets to ensure that the results are not sample specific (i.e. either CRSP only, the intersection of CRSP-Compustat or the intersection of CRSP-Compustat-Execucomp). Therefore, the phenomenon is present and the challenge in this literature is to offer a rational (or not) explanation of the stock price crash risk puzzle. The stock price

crash risk puzzle gains even more substance if one considers its theoretical value in the model of Jin and Myers (2006) which is "a crash is defined to happen at most once in 100 periods".

Although, there are numerous mechanisms that can cause sudden drops in returns, i.e. stock price crashes, prior explanations can be classified into two broad categories; the *financial market mechanisms* and the *firm-specific mechanisms*. These two categories are strictly related to the two prominent theories proposed by the literature to explain stock price crashes. The focus of the financial market theory, as established by the dominant study of Hong and Stein, (2003), is on the investor's perspective. The financial market theory states that different opinions among the investment community can be predominant for the phenomenon of stock price crash.[1]

The majority of prior studies concentrate mainly on crash risk topics linked or driven by firm-specific mechanisms. This literature builds upon agency theory arguments to suggest that information asymmetry offers the potential for self-interested behavior to be manifested by managers (Jin and Myers, 2006; Benmelech, Kandel, and Veronesi, 2010). More specifically, the theoretical development of Jin and Myers (2006) argues that information asymmetry between managers and shareholders, combined with investors' incompletely secured property rights that result in lack of transparency, enables the accumulation of bad news. Similarly, the theory established by Benmelech, Kandel, and Veronesi (2010) draws motivation from the argument that CEOs, aiming to protect and/or increase the component of firm performance which directly affects their financial rewards, exploit information asymmetries to manifest self-interested behavior and hide bad news by engaging in sub-optimal investment decisions. In both theoretical developments, the accumulation of bad news leads to stock price crashes, when the hoarded negative information suddenly becomes publicly available.

The increased interest of researchers on stock price crashes, arises with the occurrence of corporate scandals, such as Enron's collapse. The great list of corporations involved in

[1] Given that not only the divergence in opinion among investors is large, but also investors are subject to short-selling constraints, their perception cannot be directly incorporated in stock prices. Accordingly, the hoarded concealed information comes out only when the market declines and the investors sell their shares, leading to a negative skewness in the distribution of stock returns. Therefore, investor heterogeneity is considered as a catalyst to the stock price crash occurrence.

major collapses, forced policymakers to regulate financial reporting and other business practices at publicly traded companies with the adoption of the Regulation Fair Disclosure (Reg FD) in 2000 and the Sarbanes-Oxley Act (SOX) of 2002. Considering the fact that the revelation of those scandals triggers the attention of research specialists, the weight of the literature was more or less expected to be given on the firm side. Additionally, perhaps because of the familiarity of corporate finance studies with the "firm side of stories" the emphasis was placed in the Jin and Myers agency viewpoint (2006).

Theoretical explanations derived from the agency theory arguments, accentuate two significant channels underpinning the relationship between the hoarding of bad news and stock price crashes, namely financial reporting opacity and sub-optimal investment decisions. The two pre-mentioned agency-based channels enable managers to hoard bad news, i.e. withhold negative news, at least temporarily, or suspend their revelation from the investment community, to avoid experiencing directly the consequences of their negative reaction (Jin and Myers, 2006). Hoarding of bad news, has been acknowledged as the catalyst of stock price crashes, specifically at the point in which the accumulated negative information becomes available to the public (Jin and Myers, 2006). As far as the financial reporting opacity is concerned, the theoretical arguments of Jin and Myers (2006) that have been empirically tested by the seminal crash paper of Hutton, Marcus, and Tehranian (2009), show that accounting opacity, operationalized by earnings management, is an important factor driving firm-specific stock price crashes. Regarding the overinvestment channel, the theory developed by Benmelech, Kandel, and Veronesi (2010) suggests that when the growth rate of investment opportunities starts to decline, managers follow a suboptimal investment policy to conceal adverse outcomes from shareholders and overinvest to retain their expectations, which, in turn, engenders the stock price crash.

This chapter intents to synthesize the bulk of the empirical research on stock price crashes by replicating a great stream of the empirical literature on the determinants of stock price crashes after the paper of Hutton, Marcus, and Tehranian (2009), that lie on the agency theory and have been published in the top-tier finance and accounting journals. The main explanatory variables of the prominent studies, that have empirically been shown to significantly determine stock price crashes, are combined in a comprehensive study. The empirical analyses are conducted by adopting two approaches. Initially, the focus is on the main explanatory variables of the prominent studies. Instead of focusing on the firm-

level, the focus of this study is on the aggregate level. The reason that leads to approach the crash field on an aggregate view, it is because the main issues in our knowledge of stock prices crashes, arises from the fact that the existing approaches have failed to provide an explanation at an aggregate level. Therefore, the intention is to observe the average firm and understand if its behavior is broadly adopted by the majority of the firms in the sample. The adopted approach enables the investigation of the movement of the determinants that are driving stock price crashes in relation with the respective crash occurrences. Given the uprising occurrence of stock price crashes, one would expect that there is a similar trend in the factors that have been coined as causing the results. Then, regression analyses are conducted to test in a multivariate way the extracted results derived from the univariate analysis.

The chapter investigates the stock price crash incidence by focusing on the evolution of stock price crashes from 1950 to 2018. The results demonstrate the large increasing trend in the percentage of annual stock price crashes, that reaches almost 30% in 2018. Strikingly, the observed percentage is substantially high to represent an outlier. This phenomenon remains unchanged in utilizing different data sets featured by the various databases that are commonly used in crash studies, indicating that the results do not arrive due to a specific sample. As it turns out, the stock price crash risk puzzle is prevalent either by applying the common filtering criteria in the data sets or by using alternative measures (i.e. NCSKEW and DUVOL) to operationalize the stock price crashes. Furthermore, the stock price crash risk puzzle, is not industry specific. While the percentages of crashes from industry to industry vary, the increasing movement remains largely unaffected across the 12 Fama-French industries.

Assessing this stylized fact from the agency theory viewpoint, the unexpectedly high percentage could have only been justified, if it was associated with a respective increase in the incidence of the two dominant agency-based channels that are triggering the stock price crashes; accounting opacity and overinvestment. As far as accounting opacity is concerned, a decreasing trend is observed from 2011 and appears stable in the recent years with the highest crash frequencies. Regarding overinvestment channel, a decreasing trend is observed after 2002. Therefore, in stark contradiction, the trend of the two agency-based channels appeared to be rather stable, with a notable decrease after 2000, which is conceivable considering the adoption of the regulations (Reg FD and SOX) that have been established to mitigate their impact.

The occurrence of a sequence of corporate scandals leads both policymakers and academics to pay heightened attention on corporate governance issues. From the empirical evidence provided by the academia, not only accrual-based earnings management experienced a significant decline after the passage of SOX (Cohen, Dey, and Lys, 2008; Zhou, 2008), but also the new regulatory regime resulted in improved corporate-governance functions (Chang and Sun, 2009). Additionally, Lu and Wang (2015) provide empirical evidence suggesting that higher board independence is associated with less capital investment, consistent with the mitigating role of board on agency problems. Collectively, it is expected that the improvement of corporate governance, enforced by the SOX establishment, will result in the improvement of the two agency-based stock price crash channels, opacity and overinvestment. Following substantial literature on crashes, this chapter assesses the impact of corporate governance on stock price crashes (e.g. Callen and Fang, 2013, 2015; Andreou, Antoniou, Horton, and Louca, 2016; Dang, Lee, Liu, and Zeng, 2018). Considering the effort of gate keepers and fiduciary agents to improve the corporate governance mechanisms, it is expected to observe a reduction in the percentage of stock price crashes, assuming an effective improvement that enhance the monitoring and discipline process in public firms.

This assumption has led us to report the trend of various internal and external corporate governance variables over the past years. Regarding the internal corporate governance mechanisms, the average value of board size, the average percentage of duals CEOs, the average percentage of independent directors, of busy directors, of not attended directors and of female directors are being plotted (Andreou, Antoniou, Horton, and Louca, 2016; Mamun, Balachandran, and Duong, 2020). It is observed that while board size remains stable, the average percentage of duals CEOs, independent directors in the board and female directors increases and the percentage of not attended directors decreases during the last years of the sample with the highest crash frequencies.

Similarly, the average value of external corporate governance mechanisms operationalized by the average percentage of institutional ownership, HHI, and the auditor-client relationship are illustrated in graphical representation (Callen and Fang, 2013, 2017). What is observed, is an increasing trend in the average percentage of non-transient institutional ownership, a declining trend of the average HHI and a stable trend in auditors' tenure. What is known is that corporate governance mechanisms can be utilized to modify the rules under which the managers behave and re-establish the

shareholders' interests. Overall, what it is observed is that the most crucial and highly influential internal and external governance mechanisms have experienced a noticeable improvement at the aggregate level. However, what is not observed in the graphical representation, is an associated reflection of this improvement on the frequency of stock price crashes. Accordingly, some potentially open questions may arise regarding the agency theory viewpoint, that the lion's share of the firm-specific stock price crash literature has relied on.

Additional tests are conducted to validate the findings of the univariate analysis. Using two data sets of US public firms; the intersection of CRSP-Compustat and CRSP-Compustat-Execucomp, this chapter documents a weak relationship between the two agency-based channels of stock price crashes; opacity and overinvestment, and one-year-ahead stock price crashes. Specifically, in assessing the relation between the two agency-based channels with one-year-ahead stock price crashes in a multivariate framework, the study conducts logit regressions and reports their marginal effects. The findings illustrate that while overinvestment partially survives in the various specifications, the opacity, which still consists the motivation of the bulk stock price crash literature, appears insignificant in all specifications and data sets. Additionally, in subsample analysis conducted using the post SOX Sample (2003-2018), both opacity and overinvestment channel appear insignificant, indicating that the agency view in recent years does not seem to offer an explanation for the stock price crash occurrences. The findings emerge from logit model regressions controlling for the main determinants known to influence crash risk and widely adopted by the crash literature, as well as industry-fixed, year-fixed effects and firm-fixed effects. The robustness of the findings with regards to the crash risk measure used is checked by conducting supplementary analysis. The results remain qualitatively similar, when using the negative coefficient of skewness (NCSKEW), as dependent variable in OLS regression analysis.

Taken together, the connection between stock price crashes and their determinants has been a particular area of interest. The sequence of corporate scandals, as well as the recent financial crisis has revived the interest of the research community to the investigation of stock price crashes, especially from the *firm-specific view*. (e.g. Hutton, Marcus, and Tehranian, 2009; Kim, Li, and Zhang, 2011a; Callen and Fang, 2013, 2015; Kim and Zhang, 2016). This intersection which is built upon the agency theory, offers unique observation and intervention points. The bulk of the studies dealing with stock price

crashes, are built on the agency perspective of withholding bad news and have admitted the two agency-based channels as the drivers of stock price crashes. However, while it seems that crashes are more prevalent as time passes, the time evolution of the two agency-based channels, opacity and overinvestment, facilitating the hoarding of negative information, through which stock price crashes may occur, seems to attenuate in time. In the light of reported, it could be concluded that agency problems seem to have attenuated too. This raises many questions whether the emphasis of the crash literature should have been placed in the agency viewpoint.

This chapter makes several contributions to the literature. First, it provides a synthesized overview of the current state of knowledge and outlines the scope of the topic. Furthermore, this analysis paints a broader picture about a previously ignored aspect; the stock price crash puzzle. The research's investigation to identify inconsistencies in prior results and potential explanations reveals an unexpected finding which provides stimulation and, quite literally, food for thought for the research community. This unexpected finding, an aggregate improvement in corporate governance which is not associate with a reduction in stock price crashes, signal the need for additional studies to understand more completely the key tenets of the occurrences of stock price crashes. Finally, this chapter consists a presentation of the conceptual frameworks not only to reconcile and extend past research, but also to serve as a base for future work on this field. Although the current chapter is derived from an agency theory viewpoint, is the first effort to address aggregately the stock price crash occurrences. The limited ability of the agency-based channels to offer an explanation on the aggregate level, highlights the need to use a financial market side assessment tool regarding crashes. Accordingly, it could empower policymakers and planners to make more informed decisions, leading to the reduction of the percentage of stock price crashes, while also enhancing a move toward the investment community side. Therefore, a far-reaching evaluation structure that also incorporates the *financial market side* is required.

Last but not least, this chapter discusses directions for future research. Seeking for alternative explanations, a closer look at CEOs financial incentives and market microstructure characteristics offers notable insights. First, the attention is tuned to the most important components of the CEO compensation and it is observed that stock holdings demonstrate an astonishing increase. This trend introduces a possible confound in terms of whether the increased stock holdings "dis"-incentivize managers to behave

opportunistically, instead of achieving lower agency problems by aligning the interests between managers and shareholders. Then, the examination of the characteristics of the market microstructure revealed an increasing percentage of firms listed in Nasdaq stock exchange. The technological nature of Nasdaq-listed firms brings to the surface the "hype cycle model" framework which allows firms to "hype" inflated investors' expectations and drive stock price to unsustainably high levels. This could be also driven mainly by investors' enthusiasm and justified by the psychological basis of speculative bubbles, i.e. irrational exuberance. In this vein, a combination of the alternative explanations suggests that managers, due to financial incentives, might be tempted to shape investors' expectations about the firms' outcomes by providing "fluff" news and engaging in "cheap talk". Overall, it is a matter of future research to identify the agency-based channels (other than opacity and overinvestment) through which inflated firm's stock price levels can be achieved.

The study unfolds follows: Section 2 describes the data, measurements, and the methodology; Section 3 presents the summary statistics univariate and multivariate analysis; Section 4 discusses possible explanations, while Section 5 provides a conclusion to the study.

## 2 Critical review of the literature

Previous work on stock price crashes, theorizes two categories of explanatory mechanisms, derived either from the financial market side or the firm side. In recent years, the ongoing advancement on the association between stock price crashes and their determinants, intrigued the scientific world to approach the field particularly from the firm-specific view. While this convergence is built upon the agency theory (e.g. Hutton, Marcus, and Tehranian, 2009; Kim, Li, and Zhang, 2011a; Kim and Zhang, 2016; Callen and Fang, 2017), to date the plethora of the empirical work leaves the aggregate level of the stock price crash problem insufficiently explored. This section is an overview developed using the main theoretical background of stock price crashes, along with the evidence derived from the empirical literature.

As far as the financial market side is concerned, the capstone of the literature consists of the representative investor framework, established by the study of Hong and Stein (2003). The conceptual framework supporting this study derives from divergence in opinions and

argues that different opinions among the investment community can be considered as the catalyst for the occurrence of stock price crashes. Specifically, investor heterogeneity resulting from the assumptions of dissimilar believes combined with short-selling constraints, lead to asymmetrically negative movements of the market. In particular, the pessimistic investors that are subject to the short-selling restrictions are not able to sell their stocks and incorporate their beliefs in the stock prices. Therefore, the information is not fully reflected and as a result the accumulated concealed information is coming out only during a market decline when the unconstrained investors are selling their shares, leading to a negative skewness in returns' distribution.

The fundamental theoretical work of Hong and Stein (2003) is of an increasing importance in the financial market side of the stock price crash literature. Initially, Chen, Hong, and Stein (2001) proxy the intensity of disagreement using the trading volume in their empirical investigation to forecast stock price crashes. Their findings constitute evidence that differences of opinion among investors are positively related to crash risk. Consistent with the divergence of investor opinion explanation and specifically regarding firm valuation, Lobo, Wang, Yu, and Zhao (2020) find a positive association between material weakness in internal controls disclosed under Section 302 of the Sarbanes–Oxley Act of 2002 and future stock price crashes, which also increase information asymmetry between insiders and investment community. The working paper by Chang, Hsiao, Ljungqvist, and Tseng (2020), recently tests disagreement models and provides empirical evidence for the role of investor disagreement in asset pricing. The study has not identified any other published work that considers the stock price crashes from the financial market perspective, or at least any previous work that addresses this side empirically. Accordingly, this area can be further explored by the stock price crash literature.

As far as the financial market side is concerned, the capstone of the literature consists of the representative investor framework, established by the study of Hong and Stein (2003). On the other hand, the bulk of the stock price crash literature focuses on the firm side. Specifically, the literature on firm specific stock price crash risk is built upon agency theory arguments suggesting that information asymmetry offers the potential for self-interested behavior by managers (Jin and Myers, 2006; Benmelech, Kandel, and Veronesi, 2010).

On the other hand, this stream of stock price crash literature, which focuses on the firm side, is based on the theoretical development of Jin and Myers (2006). The leading theoretical study of Jin and Myers (2006) reveals that information asymmetry between managers and shareholders enables the accumulation of bad news, which can be predominant for the phenomenon of stock price crash. Accordingly, the occurrence of the stock price crashes is being ascribed to the agency problems that arise from the separation of ownership and management (Jensen and Meckling, 1976; Jensen and Smith, 2000). More specifically, because of investors' incompletely secured property rights insiders can increase their cash extraction, when the cash flows are higher than the expected cash flows from investors' perception. Accordingly, the lack of transparency (opacity) increases, along with the amount of concealed negative information in accordance with the study of Kothari, Shu, and Wysocki (2009). However, the managers' ability to conceal bad news is not unlimited. Therefore, when the hoarded hidden bad news crosses a tipping point, negative information comes out all at once in a given timespan. As a result, the accumulation of bad news leads to stock price crashes.

In the same vein, another stream of stock price crash literature is derived from the agency theory and focuses on the firm side. This theory is developed by Benmelech, Kandel, and Veronesi (2010) and draws motivation from the argument that CEOs, who are concerned about firm performance because has a direct impact on their current and future personal wealth (e.g. Bizjak and Brickley, 1993; Shleifer and Vishny, 1989; Cheng, 2004), may exploit information asymmetries to manifest self-interested behavior and hide bad news. Therefore, when the growth rate of investment opportunities starts to decline, concerns about their personal wealth can incentivize CEOs to conceal adverse outcomes from shareholders. As a result, CEOs do not reveal the bad news to the investors to retain their expectations and accordingly the level of stock price. To maintain the investors' perception that investment opportunities still exist and firm operates in a growing investment stage of its life cycle, CEOs follow a suboptimal investment policy. According to Benmelech, Kandel, and Veronesi (2010), CEOs are engaged in value-destroying investment decisions, at least temporarily, until the revelation of the real growth rate of the firm's investment opportunities, which results in the stock price crash occurrence.

The theoretical arguments presented above, are linked with the agency-based channels that facilitate the manifestation of managerial bad news hoarding activities, triggering stock price crashes. Theoretical explanations accentuate two significant channels

underpinning the relationship between the hoarding of bad news and stock price crashes, namely financial reporting opacity and sub-optimal investment decisions.

The theoretical arguments of Jin and Myers (2006) have been empirically tested through the first empirical research on firm-specific stock price crashes is presented by Hutton, Macrus, and Tehranian (2009). Hutton, Macrus, and Tehranian (2009) is a seminal paper in stock price crash literature that investigates the relation between the transparency of financial statements and the occurrence of a stock price crash. Their findings suggest that accounting opacity, operationalized by earnings management, is an important factor driving firm-specific stock price crashes. Several other studies show that top executives are incentivized to engage in earnings management practices to the detriment of shareholders (e.g. Dechow and Sloan, 1991; Park and Park, 2004; Petrou and Procopiou, 2016). A voluminous number of the subsequent studies, which are built on the agency perspective of withholding bad news, not only consider it as firm-specific stock price crash determinant factor, but also they have admitted that earnings management is the primary channel that drives crashes (e.g. Kim, Li, and Zhang, 2011a, 2011b; Cheng and Warfield, 2005; Bergstresser and Philippon, 2006). Another stream of the literature, which is built upon the agency perspective, suggests that managers may invest sub-optimally, i.e. over- or under-invest, the available funds into various investment options to serve their personal interests (e.g. Kim, Li, and Zhang, 2016; Habib and Hasan, 2017). The top executives' opportunistic behavior can adversely affect investment efficiency and result either in over- or under-investment. For instance, Habib and Hasan (2017) examined the association among stock price crashes and investment efficiency (both over and under), conditional on managerial ability. Generally, crash literature theoretically acknowledged investment inefficiency as a channel through which other CEO-related variables can affect the occurrence of a stock price crash (Kim, Wang, and Zhang, 2016).

Existing empirical work ascribed the occurrence of stock price crashes to numerous determinants. The following section concentrates several studies and offers a taxonomy of the determinants into the broad groups of CEO and firm characteristics, earnings and financial reporting quality, CEO compensation/incentives and internal and external corporate governance.

## 2.1 CEO and firm characteristics

A substantial stream of literature on stock price crashes, examines the relationship between CEO characteristics and stock price crashes (e.g. Callen and Fang, 2015; Andreou, Louca, and Petrou, 2017; Habib and Hasan, 2017; Li and Zeng, 2019). For instance, Callen and Fang (2015) show that higher level of religiosity, which proxies rules set by the society to limit hoarding of bad news, is associated with lower stock price crash occurrence. Additionally, Li and Zeng (2019), in their investigation on the impact of top executive's gender on asset prices, find that female CFOs are negatively associated with stock price crashes. Furthermore, Andreou, Louca, and Petrou (2017) provide empirical evidence that younger managers have incentives, tied to their personal wealth, to withhold negative news in the early stages of their career and therefore firms with younger CEOs are more likely to experience stock price crashes.

Prior studies rigorously investigate numerous firm related determinants of stock price crashes. CEOs can utilize voluntary disclosures to reduce asymmetric information between mangers and shareholders. Corporate social responsibility (CSR) disclosures can be considered such an example to reduce hoarding of negative information. Kim, Li, and Li (2014) investigate the effects of CSR disclosures on crash risk and confirm that better CSR disclosures are associated with less stock price crashes. In the same vein, managerial disclosure practices are enforced by the US Securities and Exchange Commission (SEC). Accordingly, SEC appears to have an impact on CEOs' choices regarding firms' disclosures. As a result, firms located near SEC offices are less likely to experience a stock price crash (Kubick and Lockhart, 2016). However, not only the voluntary disclosures, but also the accounting standards adopted by the firm appeared to have an impact on crash risk. DeFond, Hung, Li, and Li (2015) examine the adoption of international financial reporting standards (IFRS) relatively to the crash. It has been observed, that IFRS adoption, as an indication of a reduction in the ability to hoard negative information, reduces the probability to experience a stock price crash. Furthermore, the reduction in the ability to hoard negative information can be also achieved through short-term debt. Dang, Lee, Liu, and Zeng (2018) highlight the effective monitoring role of short-term debt lenders by showing a negative relationship between short-term debt and future stock price crashes. Collectively, the characteristics and regulations associated with disciplined mechanisms are expected to reduce the likelihood of observing negative return outliers.

Through the earnings management channel, top executives can use tax avoidance practices to withhold negative news. Tax avoidance enables managers to reap private benefits and stockpile negative news for prolonged periods by providing the techniques needed to justify these opportunistic behaviors. Specifically, Kim, Li, and Zhang (2011b) provide strong and robust evidence that corporate tax avoidance has a positive relation with firm-specific stock price crashes. Therefore, it is generally expected that tools facilitating rent extraction will affect positively the probability to observe more crashes.

Moreover, firms experiencing financial constraints, which can be manifested as frictions to rise funding from outside investors, have more incentives to engage in hoarding of bad news which, in turn, leads to negative extreme returns (Hen and Ren, 2017). Accordingly, when the firms are straggling in finding the necessary resources to pursue desired investment options, may more easily withhold unfavorable information that will leave them one more step behind their target.

## 2.2 Earnings and financial reporting quality

With respect to the quality of earnings, crash literature provides evidence suggesting that stock price crash risk is positively related to accounting opacity (Hutton, Marcus, and Tehranian, 2009; Hong, Kim, and Welker, 2017) and negatively related to conditional conservatism (Kim and Zhang, 2016). As it is prementioned, the empirical study of Hutton, Marcus, and Tehranian (2009), investigates the transparency between financial reporting and stock return distribution and shows that opacity is related with higher R2's, which is an indication of lower flow of firm-specific information to the market and hence, opaque firms are more susceptible to experience stock price crashes. On the other hand, conditional conservatism, which mainly refers to the asymmetric propensity of accountants to require to be more assured to accept the positive news as gains than the negative as losses (Basu, 1997), can mitigate the likelihood of withholding negative news or overstate positive news (Kothari, Ramanna, and Skinner, 2010). Specifically, Kim and Zhang (2016) show that conditional conservatism limits managers' incentives and ability to overstate performance. Most recent researches on the field of stock price crashes argue that after SOX of 2002 top executives instead of the prementioned earnings management practices, now use real earnings management. Specifically, Francis, Hasan, and Li (2016) calculated firms' abnormal business operations based on real earnings management models. They show that firms' deviation in real operations from industry norms has a

positive impact on future stock price crashes. Additionally, Cheng, Li, and Zhang (2020), find a positive association between operating cash flow opacity and future stock price crash risk, suggesting that it facilitates hoarding of negative information and enables managerial resource diversion. Finally, Chen, Kim, and Yao (2017) provide empirical evidence suggesting the theoretical hypothesis that managers utilize earnings smoothing as a practice that enable them to exploit personal financial incentives (e.g. meet a target set to earn bonus) or due to career concerns (e.g. to ensure their job security). In summary, the practices or techniques associated with a lower quality of earnings, are linked with a higher propensity of stock price crashes.

There is also a considerable amount of research investigating the relation between financial reporting quality and stock price crashes. Specifically, Ertugrul, Lei, Qiu, and Wan (2017) studied the impact of various aspects related to 10K annual reports (i.e. the size and the written tone of the filing) on firm-specific crashes. Their findings suggest that larger 10K's with more words related to the uncertainty and weakness are associated with more stock price crashes. In the same spirit, Kim, Wang, and Zhang (2019) reported that less readable 10K's are also associated with more stock price crashes. In collective, managers can use more complex reports, both in terms of size and wording, to hide adverse information from the investment community, that results in extreme negative values in the returns' distribution.

## 2.3 CEO compensation/incentives

The managerial compensation, ownership and incentives are often acknowledged by the literature as an effective way to mitigate agency costs (Murphy, 1999; Florackis, 2008). Regarding top executives' compensation, in a major advance in 2011, Kim, Li, and Zhang investigated the relationship between top executives' equity incentives and stock price crash risk and found a weak positive relation between CEOs' incentives and stock price crash risk. There is also evidence that CEO stock option incentives increase stock price crash risk (Andreou, Antoniou, Hutton, and Louca, 2016). Additionally, admitting compensation package as a mechanism used to align managers and shareholders' interests, He (2015) documented that CEO inside debt holdings are associated with a reduction in the likelihood of observing firm-specific stock price crashes. In general, if the optimal executive compensation package is achieved it should be considered as an effective tool to mitigate agency problems. However, this is not always the case, since an

ineffective combination may instead result in “dis-incentives” (Benmelech, Kandel, and Veronesi, 2010) and lead managers to make decision to the detriment of shareholders’ welfare. Moreover, in the presence of managerial career concerns, there is evidence supporting that it is challenging to determine the optimal incentive contract (Gibbons and Murphy, 1992). In this vein, He, Ren, and Taffler (2020) consistent with executives’ trading activities for gaining personal benefits, find a positive relation between insider sales and future crash risk.

## 2.4 Corporate governance

The literature on stock price crashes, has related the importance of corporate governance mechanisms to the likelihood of crashes. In the absence of appropriate monitoring, CEOs might undertake actions that maximize their own wealth to the detriment of shareholders’ welfare (e.g. Callen and Fang, 2013, 2015; Andreou, Antoniou, Horton, and Louca, 2016; Dang, Lee, Liu, and Zeng, 2018). Even though in firms with high agency problems, CEOs may exploit information asymmetry to manifest self-interested behavior and hide bad news by being involved in actions that enable them to stockpile the negative information from the investment community, this behavior is more difficult to be manifested in the presence of proper monitoring. Much work on the importance of various corporate governance mechanisms, both internal and external, has been carried out, emphasizing on their role in mitigating stock price crash risk (e.g. Callen and Fang, 2013; Andreou, Antoniou, Horton, and Louca, 2016).

### 2.4.1 Internal Corporate governance

Several studies have been also carried out regarding the internal corporate governance, in terms of analyzing the composition of the board. Andreou, Antoniou, Horton, and Louca (2016) have related the importance of various corporate governance mechanisms in mitigating stock price crash risk. They mentioned that their findings are stronger in firms with high agency risks. In the same vein, Al Mamum, Balachandran, and Duong (2020) explored the influence of powerful CEOs, by observing the dual role of CEO and chair which implies that dual-CEOs are more able to coordinate board activities and impose their preferences on certain outcomes. In their analysis, powerful CEOs appeared to be associated with hoarding of negative information and accordingly more stock price crashes. Additionally, Kang, Kim, and Liao (2020), provide empirical evidence

supporting the crash risk–reducing role of bankers on the board, consistent with their financial expertise in risk management and conflicts of interest between shareholders and debtholders.

### 2.4.2 External Corporate governance

Numerous researches also highlight the important role of external governance mechanisms on having an impact on the stock price crash occurrence. In line with the monitoring-by-learning hypothesis, which supports that a longer auditor–client relationship (i.e. a greater client-specific knowledge) enables professional firms providing Audit services not only to recognize but also to prevent their clients from concealing negative information, there is empirical evidence that a longer auditor–client relationship decreases the risk of experiencing a sudden stock price drop (Callen and Fang, 2017). Nevertheless, many studies have also been made aiming to observe the impact of external corporate governance on stock price crashes. More specifically, prior empirical findings on the role of institutional investors, provide supporting evidence for the monitoring of dedicated institutions instead of the short-termism perspective of their role (Callen and Fang, 2013; An and Zhang, 2013). Moreover, Ni, Peng, Yin, and Zhang (2020) report a positive relation between institutional investor distraction and stock price crashes. To sum up, any improvements in the above-mentioned mechanisms can be considered as a significant, either internal or external, governance solution to agency problems that thereby limits CEOs' ability to extract rents, monitors their actions and reduces the hoarding of bad news, along with the probability of observing extreme negative values in returns.

In summary, the firm characteristics and regulations associated with disciplined mechanisms, practices or techniques related with a higher quality of earnings are expected to reduce the likelihood of observing extreme negative returns. On the other hand, financially constrained firms, or firms with tools facilitating rent extraction and firms with a lower financial reporting quality have a higher probability of experiencing strong price crashes. Additionally, managers may have financial incentives, career concerns, psychological biases, or personal motives that lead them to stockpile bad news, leaving their firms more prone to stock price crashes. However, an effective compensation structure, aiming to align the interests of CEOs and shareholders, as well as internal and external corporate governance mechanisms that may enhance monitoring, can be

considered as a solution that mitigates the problems arising from the separation of ownership and management, which is acknowledged by the plethora of studies as the catalyst of stock price crashes.

# 3 Research design

The data for stock price crashes are drawn from the Center for Research in Security Prices (CRSP) for the period 1950 to 2018. The initial results feature the stock price crash measure (CRASH). For this initial analysis, the sample covers common stocks (i.e. share code 10 and 11) that are being traded in NYSE, Amex or Nasdaq, without imposing any other filtering rules (e.g. Callen and Fang, 2015). Subsequently, to ensure that the results are not sample specific, the results for stock price crash measure are reported using: (i) the intersection of CRSP and Compustat for the period 1962 to 2018 and (ii) the intersection of CRSP, Compustat and Execucomp for the period 1992 to 2018. Finally, and in accordance with the extant studies, the analysis is conducted after imposing the common filtering criteria used by the stock price crash literature (e.g. Kim, Li, and Li, 2014; Kim and Zhang, 2016), specifically, the analysis does not include firm-years with (i) a stock price less than $1 at the end of fiscal year, and (ii) fewer than 26 weeks of stock returns in a fiscal year. For this filtered data set, the evolution of crashes is again reported using: (i) the intersection of CRSP and Compustat for the period 1962 to 2018 and (ii) the intersection of CRSP, Compustat and Execucomp for the period 1992 to 2018.

The majority of the analysis exploits the intersection of CRSP and Compustat for the period 1962 to 2018, which comprises the baseline sample. Several variables related to the channels through which crashes may occur, firm characteristics, CEO characteristics, CEO compensation components and pay incentives, stock exchange, corporate governance related variables and institutional ownership have been estimated. The sample differs in each analysis and is restricted due to the sufficient data to calculate the variables used. For instance, the inclusion of Execucomp data leads to a smaller sample, albeit representative to the samples used in other studies.

## 3.1 Crash risk measure

Jin and Myers (2006) define the firm-specific stock price crash as an extreme negative value in the distribution of stock returns. Following their definition, the first crash risk measure, namely CRASH, is constructed by adopting the expanded model used in Kim,

Wang, and Zhang (2016) study. The stock price crash indicator variable requires the estimation of firm-specific weekly returns as the residuals from the following ordinary least squares (OLS) regression of the expanded index model (1):

$$r_w = a + b_1 r_{MKT,w-2} + b_2 r_{MKT,w-1} + b_3 r_{MKT,w} + b_4 r_{MKT,w+1} + b_5 r_{MKT,w+2} + b_6 r_{IND,w-2} + b_7 r_{IND,w-1} + b_8 r_{IND,w} + b_9 r_{IND,w+1} + b_{10} r_{IND,w+2} + e_w \quad (1)$$

where $r_w$ is the return on stock in week w, and $r_{IND,w}$ is the Fama and French value-weighted industry index and $r_{MKT,w}$ is the value-weighted market index in that week, as obtained from CRSP database. The inclusion of two lead and lag terms of market and industry indexes allows for non-synchronous trading (Dimson, 1979). The initial analysis is also employed with the measure of stock price crashes estimated using only the market factors.

At the next stage of the estimation process, the firm-specific weekly returns for firm in week t ($W_w$) are measured as follows:

$$W_w = \ln (1 + e_w) \quad (2)$$

The estimation of the above equations requires at least 26 weekly observations, so the sample is restricted into those fiscal years. Following Hutton, Marcus, and Tehranian (2009), a week is defined as a "crash week", when the firm-specific weekly returns fall at least 3.09 standard deviation below the mean firm-specific weekly return value in year *t.* The first crash measure, namely CRASH, is an indicator variable set equal to one if a firm experiences one or more crash weeks during a fiscal year, and zero otherwise.

This chapter also utilizes two continuous measures of stock price crashes, namely negative coefficient of skewness (NCSKEW) and down-to-up volatility (DUVOL), as have been proposed by Chen, Hong, and Stein, (2001). NCSKEW is calculated by taking the negative of the third moment of firm-specific weekly returns and dividing it by the standard deviation of firm-specific weekly returns raised to the third power. Thus, for any stock j in year t:

$$NCSKEWj,t = -(n(n-1)^{\frac{3}{2}} \sum w_{j,t}^3)/((n-1)(n-2)(\sum w_{j,t}^2)^{\frac{3}{2}}) \quad (3)$$

where $w_{j,t}$ represents the sequence of weekly returns to stock j during year t, and n is the number of observations on weekly returns during the year.

The last continuous crash risk measure, DUVOL, is defined as the natural logarithm of the ratio of the volatilities of 'down' weeks to 'up' weeks. A week is considered as "down" ("up") when the firm-specific weekly return ($W_w$) is below (above) the estimation period's mean weekly return. Specifically, it is calculated as:

$$DUVOL_{j,t} = log\left(\frac{(n_u\text{-}1)\sum_{DOWN} W_w^2}{(n_d\text{-}1)\sum_{UP} W_w^2}\right) \quad (4)$$

where $n_u$ and $n_d$ are the number of "up" and "down" weeks and $w_{j,t}$ represents the sequence of weekly returns to stock j during year t, and n is the number of observations on weekly returns during the year.

Except from the crash risk indicator variables, crash literature utilizes also the NCSKEW and DUVOL measures. Although the estimation of these measures is also based on the firm-specific weekly returns, they take continuous values. These measures are proposed to capture the negative asymmetry in the dispersion of firm's stock returns, meaning that they have the tendency to identify stocks with a more left-skewed distribution, that are just more prone to experience a stock price crashes in general (Chen, Hong, and Stein, 2001). Additionally, there is evidence that they may capture even smaller or medium-sized crashes which are mainly caused by the asymmetry on the distribution of returns (Andreou, Cooper, Louca, and Philip, 2017). Remarkably, the fact that negative returns' asymmetry may arise exclusively by more than a few less extreme negative returns, does not primarily always comply with the idea that the occurrence of a stock price crash is caused when the accumulated bad news is suddenly released and manifested as a negative outlier in the distribution of firm-specific returns (Ak, Rossi, Sloan, and Tracy, 2016; Andreou, Cooper, Louca, and Philip, 2017). Therefore, to serve the purpose of the study, i.e. capture the firm-specific crashes as defined by Jin and Myers (2006), the subsequent analysis is conducted by employing the crash risk indicator variable.

## 3.2 Channels of stock price crashes

The agency theory viewpoint of the occurrence of firm specific stock price crashes is built upon the theoretical arguments of Jin and Myers (2006) and Benmelech, Kandel, and Veronesi (2010), indicating two channels that enable the manifestation of hoarding of bad news which, in turn, triggers the stock price crash occurrence. These two agency-based channels, namely financial reporting opacity and overinvestment, are being defined below.

### 3.2.1 Opacity

Asymmetric information between managers and shareholders, coupled with not fully secured rights of investors, allow top executives to withhold negative information (Jin and Myers, 2006). Subsequently, the accumulated bad news concealed from the investment community causes lack of transparency, i.e. opacity. A higher value of opacity indicates that the financial reports are less transparent, which means that less firm-specific information is publicly available. There is evidence suggesting that accruals management obscures at least some firm-specific information and proxies the propensity of executives to conceal news from investors (Sloan, 1996). Following Hutton, Marcus, and Tehranian (2009), opacity is measured as the prior three years' moving sum of the absolute value of discretionary accruals (*DACC*), where *DACC* is measured as follows:

$$DACC_t = \frac{TA_t}{ASSETS_{t-1}} - (\widehat{a_0}\frac{1}{ASSETS_{t-1}} + \widehat{b_1}\frac{\Delta SALES_t - \Delta RECEIVABLES_t}{ASSETS_{t-1}} + \widehat{b_2}\frac{PPE_t}{ASSETS_{t-1}}) \quad (5)$$

where Total Accruals (TA) are estimated as income before extraordinary items, minus cash flow from operating activities adjusted for extraordinary items and discontinued operations and regressed on the following cross-sectional regression equation using the firms in each Fama and French 48 industries for each fiscal year:

$$\frac{TA_t}{ASSETS_{t-1}} = a_o\frac{1}{ASSETS_{t-1}} + b_1\frac{\Delta SALES_t}{ASSETS_{t-1}} + b_2\frac{PPE_t}{ASSETS_{t-1}} + e_t \quad (6)$$

where TA denotes total accruals, ASSETS denotes total assets, ΔSALES denotes change in sales, ΔRECEIVABLES denotes change in receivables and PPE denotes property, plant, and equipment.

### 3.2.2 Overinvestment

The theoretical development of Benmelech, Kandel, and Veronesi (2010) is motivated by the argument that information asymmetry enables managers to employ overinvestment, as a mean to conceal bad news. Specifically, this behavior is manifested when the growth investment opportunities are declining and managers' increased concerns regarding their personal compensation incentivize them to hide bad news with the aim to secure their renumeration. Accordingly, pretending that the growth options are still prevalent, they engage in overinvestment to retain investors' expectations. In the presence of agency problems, managers are squandering free cash flows, i.e. cash flows that exceed the required amount to maintain assets in place and to finance expected new investments, by

engaging in wasteful expenditure (Jensen, 1986; Stulz, 1990). A higher amount of overinvestment indicates a greater investment expenditure beyond the necessary amount to maintain assets in place and to finance expected new investments in positive NPV projects. Overinvestment during the fiscal year is measured following Richardson's (2006) approach. To capture the accumulated effect of overinvestment, which is consistent with the hoarding of bad news theory, the study utilizes an aggregated measure of overinvestment, similarly to the opacity's measure, estimated as the prior three years' residuals from the following regression model:

$$I_{NEWt} = a_o + b_1 \frac{V_{AIP}}{MV}_{t-1} + b_2 LEVERAGE_{t-1} + b_3 CASH_{t-1} + b_4 AGE_{t-1} + b_5 SIZE_{t-1} + b_6 STOCK\ RETURN_{t-1} + b_7 I_{NEWt-1} + e_t \quad (7)$$

where $V_{AIP}$ denotes the value of assets in place and is measured as:

$$V_{AIP} = (1 - ar)BV + (1 + r)OI - arD \quad (8)$$

where $BV$ is the book value given by common ordinary equity, $OI$ is the operating income after depreciation, $D$ is annual dividends, $r$=12% (Richardson, 2006) and $a = AEP/(1 + r - AEP)$ where AEP is the abnormal earnings persistence parameter from the Ohlson (1995) framework and equal 0.62, MV is the market value of equity, LEVERAGE is the sum of debt in current liabilities and long-term debt divided by book value of equity, CASH is the balance of cash and short term investments deflated by total assets at the start of the year, AGE is the natural logarithm of the number of years that the firm is covered in the Compustat universe, SIZE is the natural logarithm of total assets at fiscal year-end and STOCK RETURN is the stock returns for the year prior to the investment year.

$I_{NEW}$ is the difference between $I_{TOTAL}$ and $I_{MAINTENANCE}$ where $I_{TOTAL}$ denotes the total investment expenditure and is measured as the sum of capital expenditure, acquisition expenditure and research and development expenditure less cash receipts from sale of property, plant, and equipment and $I_{MAINTENANCE}$ denotes the investment expenditure necessary to maintain assets in place and is measured as the depreciation and amortization.

$I_{NEW}$ is decomposed into the expected investment expenditure in new positive NPV projects, and abnormal/unexpected investment. The abnormal/unexpected investment, which can be either negative/positive denotes the underinvestment/overinvestment.

## 3.3 Determinants of stock price crashes

Many determinants, all framed from an agency perspective, have been proposed by the literature on stock price crashes. This section presents the measures for the stock price crash determinants that have been utilized in the empirical analysis. The subsequent taxonomy serves the purpose of the study and enables the investigation of the stock price crash puzzle. Except from the stock price crash agency-based channels that have been presented in the previous section, the following three classification categories are also considered: 1. Internal corporate governance, 2. CEO compensation/incentives, 3. External corporate governance.

### 3.3.1 Internal corporate governance

Numerous studies have been carried out on the importance of various corporate governance mechanisms, underlining their role in mitigating stock price crash risk (e.g. Andreou, Antoniou, Horton, and Louca, 2016). This chapter examines the evolution of various internal corporate governance mechanisms over time, specifically by plotting the average Board Size measures as the total number of directors in the board, the percentage of Independent Directors measured as the number of independent directors divided by the board size, the percentage of Female Directors measured as the number of female directors divided by the board size, the percentage of Busy Directors measured as the number of directors who are also members of other Major Company Boards divided by the board size, the percentage of Directors-not attend measured as the number of directors who attended less than 75% of the board meetings divided by the board size and the average CEO-Duality as the percentage of CEOs who are also Chairmen of the board.

### 3.3.2 CEO compensation/incentives

The relationship between executives' financial incentives and stock price crash risk has also been under consideration (e.g. Kim, Li, and Zhang, 2011). This chapter examines the evolution of various CEO compensation components and incentives over time. Particularly, the graphical representation includes the average Total Compensation measured as the sum of Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Total Value of Stock Options Granted (using Black-Scholes), Long-Term Incentive Payouts, and All Other Total, the percentage of Salary measured as the dollar value of the base salary (cash and non-cash) earned by the CEO during the fiscal year

divided by total compensation, the percentage of Bonus measured as the dollar value of a bonus (cash and non-cash) earned by the CEO during the fiscal year divided by total compensation, the percentage of Stock Holdings measures as the Total Value of Restricted Stock Granted during the fiscal year divided by total compensation, the percentage of Option Holdings measured as the Total Value of Stock Options Granted (using Black-Scholes) during the fiscal year divided by total compensation, the CEO Pay Slice (CPS) measured as the percentage of the total compensation of the top five executives that goes to the CEO and the Stock and Option Incentives ratio following Bergstresser and Philippon (2006) .

### 3.3.3 External corporate governance

The mitigating role of various corporate governance mechanisms on the occurrence of stock price crashes, is not limited only in internal mechanisms, but extends in external corporate governance mechanisms that have intrigued researcher's attention for further investigation (e.g. Callen and Fang, 2013). This study illustrates the evolution of various external corporate governance mechanisms over time. Specifically, the plots present the percentage of Non-Transient institutional investors (the sum of dedicated and quasi-indexers) and Transient institutional investors following the classifications as in Bushee (1998, 2001), the average Herflndahl-Hirschman index (HHI) measured as the sum of the square market share of all the firms in an industry, where the market share refers to the sales of the firm over the total sales of all firms in each industry and the average Auditor Tenure measured as the number of consecutive fiscal years that the auditor has been retained by the client, up to and including the current year.

## 3.4 Control variables

The analysis considers numerous control variables proposed by literature as having a predictive power in explaining the occurrence of a stock price crash. The study demonstrates the evolution of the main firm-level variables, that include Leverage, the ratio of total liabilities to total assets; Market to Book, the ratio of market value to book value of equity; Return on Equity, the ratio of income before extraordinary items to equity; Return on Assets, the ratio of income before extraordinary items to total assets; Size, the natural logarithm of total assets at fiscal year-end; and Firm Age, the number of years that the firm is covered in the Compustat universe. Furthermore, the plots show the

trend for detrended turnover (Dturn), the detrended average weekly stock trading volume during the fiscal year, which captures time-varying impacts on skewness (Chen, Hong, and Stein, 2001). Smaller firms, younger firms with less experience, firms with high growth, firms with less profits and more leverage are expected to be more prone to experience a stock price crash. Furthermore, firms with higher past returns are appeared to have a more negative skewness (Harvey and Siddique, 2000).

# 4 Discussion of empirical findings

## 4.1 Summary Statistics

Table 1.1 displays the summary statistics (Panel A) for the three alternative crash risk measures, namely CRASH, NCSKEW and DUVOL, and the main control variables. Specifically, Panel A1 refers to the CRSP-Compustat data set (1962-2018) which consists of 106,740 observations. The mean value (standard deviation) of CRASH is 0.145 (0.352), suggesting that 14.5% of firm-years experience one or more crash events. The mean value (standard deviation) of NCSKEW and DUVOL are -0.063 (0.727) and -0.083 (0.343), respectively. Although a greater sample than the plethora of crash studies is utilized, the average percentage of stock price crashes is in line with the mean CRASH value of 16.1% and the mean NCSKEW value of -0.079 reported in Kim, Li and Zhang (2011). With respect to the agency-based channels, the mean value (standard deviation) of Opacity is 0.241 (0.441), figures similar to those reported in Hutton, Marcus, and Tehranian (2009). The mean value (standard deviation) of Overinvestment is 0.044 (0.210), consistent with Richardson (2006). The distribution characteristics of the main control variables are largely consistent with those reported in prior studies utilizing CRSP-Compustat data set (e.g. Callen and Fang, 2017; Chen, Kim, and Yao, 2017; Dang, Lee, Liu, and Zeng, 2018). For instance, the average firm in the sample has a size of 5.62 (1.997), sales of 2154.59 (10878.29), market capitalization of 2023.3 (6227.82), firm age of 18.751 (13.69), market to book ratio of 2.56 (3.366) and leverage of 0.497 (0.222). The sample firms have a mean (standard deviation) return on equity of 0.034 (0.406) and a mean (standard deviation) return on assets of 0.014 (0.153). The detrended average weekly stock trading volume is 0.001 (0.016).

Panel A2 refers to the CRSP-Compustat-Execucomp data set (1992-2018) which consists of 32,203 observations. As seen, the mean value (standard deviation) of CRASH is 0.199

(0.4), suggesting that 19.9% of firm-years experience one or more crash event. The mean value (standard deviation) of NCSKEW and DUVOL are 0.084 (0.745) and -0.001 (0.345), respectively. As it is expected, the firms in CRSP-Compustat-Execucomp intersection appear more prone to stock price crashes, since the sample refers to a more recent time period. The distribution characteristics of the main control variables are largely consistent with those reported in prior studies utilizing CRSP-Compustat-Execucomp data set (e.g. Kim, Li and Zhang, 2011; Kim, Wang and Zhang, 2016). For instance, the average firm in the sample has a size of 7.327 (1.586), sales of 5632.45 (18671.68), market capitalization of 5439.92 (10006.09), firm age of 26.446 (16.992), market to book ratio of 3.227 (3.627) and leverage of 0.521 (0.221). The sample firms have a mean (standard deviation) return on equity of 0.085 (0.359) and a mean (standard deviation) return on assets of 0.042 (0.106). The detrended average weekly stock trading volume is 0.001 (0.018). It is observed that the distribution characteristics of the main control variables are substantially different in the CRSP-Compustat-Execucomp data set compared to the CRSP-Compustat data set. For instance, the average firm in the intersection of CRSP-Compustat-Execucomp has a greater size, more than doubled the amount of sales and market capitalization, on average 8 more years since establishment and greater return on both equity and assets. All the differences between Panel A1 and Panel A2 have been tested for the equality and are statistically significant ($p<.0001$), except the Leverage and Dturn.

Table 1.1, Panel B displays the Pearson correlation for the three crash risk measures, for the two different data sets; CRSP-Compustat (1962-2018) and CRSP-Compustat-Execucomp (1992-2018). The results among the different data sets are more or less the same. Specifically, while the two alternative continuous measures of crash risk, NCSKEW and DUVOL, are almost perfectly correlated with a ratio that exceed the 0.95, the correlation of the indicator CRASH variable with NCSKEW and DUVOL is around 0.6 and 0.55, respectively. All the coefficients are statistically significant ($p<.0001$). Therefore, it can be concluded that although the measures are highly correlated, they cannot be used interchangeably by the crash studies, since the CRASH indicator variable seems to capture some different aspects relatively to the two continuous measures, NCSKEW and DUVOL.

**[Insert Table 1.1, here]**

## 4.2 Univariate analysis

Figure 1.1 illustrates the frequencies of stock price crashes estimated by using the market-industry model, requiring in the initial sample only common stocks (i.e. share code 10 and 11) that are being traded in NYSE, Amex or Nasdaq (i.e. exchange code 1,2 and 3 respectively). The frequencies are presented for: (i) CRSP for the period 1950 to 2018, (ii) the intersection of CRSP and Compustat for the period 1962 to 2018 and (iii) the intersection of CRSP, Compustat and Execucomp for the period 1992 to 2018. Figure 1.1 is plotted after imposing the common filtering criteria used by the stock price crash literature. Specifically, the crash risk measure is estimated after excluding firm-years with (i) a stock price less than $1 at the end of fiscal year, and (ii) fewer than 26 weeks of stock returns in a fiscal year. The figures show that the percentage of stock price crashes has grown from 5.5% in 1950 to 24% in 2018 for the CRSP sample. This percentage rises to almost 27% in 2018, demonstrating a slightly higher crash frequency for firms in the Execucomp database relatively to the other two data sets.

**[Insert Figures 1.1, here]**

Similarly, Figure 1.2 illustrates the time evolution of the two continuous crash risk measures, namely NCSKEW and DUVOL for the average US-listed firm from 1962 to 2018. Higher values of either NCSKEW or DUVOL indicate higher stock price crash risk. The trend observed in Figure 1.2 confirms the previous evidence. Overall, the figures reveal a slightly higher stock price crash risk for firms in the Execucomp database relatively to the Compustat data set.

**[Insert Figure 1.2, here]**

In an attempt to alleviate concerns that the observable trend is driven by industries that are more prone to stock price crashes, Figure 1.3 is plotted. Figure 1.3 demonstrates the frequencies of stock price crashes per Fama-French 12 Industry, using the intersection of CRSP and Compustat for the period 1962 to 2018. Although, as it was expected the percentages of crashes differ from industry to industry, interestingly the trend remains largely unchanged across the 12 Fama-French industries. The frequency of crashes again is significantly higher in the second half of the sample period than in the first half.

**[Insert Figure 1.3, here]**

Figures 1.1 and 1.2 highlight the frequency of crashes across the three data sets. Given Hutton, Marcus, and Tehranian (2009) definition of a crash, "if firm-specific returns were normally distributed, one would expect to observe 0.1% of the sample firms crashing in any week", resulting in a crash probability of 5% over the year. Interestingly, in practice the observed percentage of stock price crashes reaches almost 30% in 2018. This finding is consistent with existing evidence suggesting that returns exhibit negative skewness (Chen, Hong, and Stein, 2001; Theodossiou, 2015). At that point, the observable percentage of crashes, is questionable. How is possible a percentage such as 30% to represent an extreme outcome, i.e. an outlier in the distribution of firm-specific returns? However, this is not the only doubtful issue. The figures illustrate that little is known about the trend of stock prices crashes over time. Therefore, it is not only that on average there is a high incidence of stock price crashes in the recent years, but also there is an increasing trend on the percentages of stock price crashes over the time period.

Assessing this stylized fact from the firm side perspective, the attention has been turned to the two channels underpinning the relationship between the hoarding of bad news and stock price crashes, namely opacity and overinvestment. Thus, the study presents the evolution of the two agency-based channels over time, using (i) the intersection of CRSP and Compustat with sufficient data to calculate the variables of interest, ending up with a sample for the period 1974 to 2018 and (ii) the intersection of CRSP, Compustat and Execucomp for the period 1992 to 2018. The high crash percentage could have been justified, if it follows a respective increase of the incidence of the two dominant agency-based channels supposed to be triggering the stock price crashes. As far as opacity is concerned (Figure 1.4), it is observed that while was increasing in the first years of the sample, after 2003 demonstrates a decreasing trend until 2008, raises again until 2011 and then decreases and appears stable in the last years of the sample, where the crash reaches the highest frequencies. A similar trend, with a lower degree, is observed for firms in the Execucomp universe, where opacity appear to decrease after 2009. As far as overinvestment is concerned (Figure 1.5), a decreasing trend is observed after 2002. A similar trend, with a higher degree, is observed for firms in the Execucomp universe. The stable and decreasing trend was expected considering the adoption of the regulations (Reg FD and SOX) that have been established to enhance transparency and mitigate the impact the two agency-based channels. Accordingly, the movement of the two agency-based channels fail to justify the incidence rate of stock price crashes, leaving unanswered the

questionable increasing number of crashes and the channels through which stock price crashes are being triggered.

**[Insert Figures 1.4 and 1.5, here]**

The bulk of the empirical studies on stock price crashes, are built upon the agency viewpoint of withholding bad news and have admitted the above-mentioned agency-based channels as the drivers of stock price crashes. Notwithstanding, while it appears that the occurrence of crashes is more frequent over the time period, it cannot be linked to the two channels, opacity and overinvestment, since their trend suggest that agency problems have attenuated. Since stock price crashes are assessed from an agency theory viewpoint, corporate governance mechanisms cannot be missing from the analysis. More specifically, effective corporate governance mechanisms can mitigate agency problems by acting as monitoring and discipline mechanisms. Given that the absence of appropriate monitoring enables managers to manifest self-interested behavior, it is conjectured that the increased incidence of crashes may be associated with poor monitoring. At that point, the focus is turned on the monitoring role of both internal and external corporate governance mechanisms. Thus, the study plots the average value of internal corporate governance mechanisms for (i) the intersection of CRSP and Compustat and (ii) the intersection of CRSP, Compustat and Execucomp. Figure 1.6 demonstrates that the board size remains stable during the last years, the average percentage of duals CEOs declined significantly from 65% to 40%, while the average percentage of independent directors in the board increased from 58% to 82%. Additionally, the average percentage of busy directors and the average percentage of not attended directors, decreased from 23% to 20.5% and 2.5% to 0.5%, respectively. On the other hand, the average percentage of female directors from 7% reaches almost 21% in 2018. Interestingly, all the various internal governance mechanisms have improved markedly.

**[Insert Figure 1.6, here]**

In the same vein, the research presents the average value of external corporate governance mechanisms for (i) the intersection of CRSP and Compustat and (ii) the intersection of CRSP, Compustat and Execucomp. Regarding the institutional ownership, although the average percentage of transient institutional ownership appears to fluctuate during the last years of the time period (Figure 1.7b), the average percentage of non-transient institutional ownership, which is directly linked with the enhancement of the

monitoring, has grown significantly from 15% to approximately 60% in 2018 (Figure 1.7a). Additionally, the movement of the HHI is illustrated, conjecturing that a competitive environment may exert pressure to the firm's management and generally act as a natural discipline mechanism. Again, the declining trend of the average HHI (Figure 1.7c) fails to justify the increasing trend of stock price crashes, since the lower value of the index indicates a less concentrated industry, i.e. a more competitive industry. Finally, Figure 1.7d presents the average auditor tenure. Overall, a stable trend is observed, especially for firms in the Execucomp universe, with 15-20 years of tenure, which is a satisfactory time period for the auditors to acquire the so-called client-specific knowledge that improves their ability to detect and prevent activities related to hoarding of bad news. What is again observed, is a noticeable improvement in the various external corporate governance mechanisms that cannot provide a rationale for the intensive crash occurrences.

**[Insert Figure 1.7, here]**

## 4.3 Multivariate analysis

To obtain a preview of the impact of the two agency-based channels variables on stock price crashes, this section conducts regression analyses using both CRSP-Compustat and CRSP-Compustat-Execucomp intersection.

First, using logit model, CRASH variable is regressed on the agency-based channels of stock price crashes, Opacity and Overinvestment, and other control variables. The results are reported in Table 1.2. Panel A shows the results derived from the CRSP-Compustat sample. The models (1) to (4) include Year and FF12 Industry Fixed Effects, while the models (5) to (8) include Year and Firm Fixed Effects. As far as the stock price crash risk channels are concerned, accounting opacity appears statistically insignificant in all model specifications. The overinvestment channel is significant and positively associated with one-year ahead stock price crash risk. This result remains significant after the inclusion of the market-related variables. For instance, in the models (2) and (4), the marginal effects of overinvestment are 0.006 and 0.005, respectively, and statistically significant ($p<0.001$). Furthermore, the marginal effects become stronger with the inclusion of Firm Fixed Effects. Specifically, the overinvestment is 0.009 ($p<0.05$) and 0.007 ($p<0.05$) in models (6) and (8), respectively. Regarding the control variables, models (3) and (4) show that Stock Return and Dturn are significant and positively associated with one-year ahead

stock price crash risk, consistent with Chen, Hong, and Stein (2001). Remarkably, the marginal effects of the market-related variables are higher compared to the marginal effects of the channels. For instance, the marginal effect of Stock Return and Dturn is 0.009 for both explanatory variables in model (4), while the marginal effect of overinvestment is only 0.005. This comparison is more pronounced in model (8), where Stock Return and Dturn are 0.018 and 0.015, respectively, but the marginal effect of overinvestment is only 0.007.

The results regarding the control variables are generally consistent with prior studies. Specifically, the coefficients on Size, Market To Book and Roe are positive and statistically significant, implying that an increase in each of the variables is associated with a greater probability to experience a stock price crash, consistent with the findings of prior studies (e.g. Chen, Hong, and Stein, 2001; Kim, Li, and Zhang, 2011; Chen, Kim, and Yao, 2017). On the other hand, there is a negative and statistically significant relationship between Leverage and the occurrence of a stock price crash, as in prior studies.

Then, the same logit regressions are conducted for the CRSP-Compustat-Execucomp data set (1992-2018). The results are reported in Table 1.2. Panel B shows the results derived from the CRSP-Compustat-Execucomp sample, which are qualitatively similar with the results derived from the intersection of CRSP-Compustat. With regards to the stock price crash risk channels, accounting opacity appears again statistically insignificant in all model specifications, while overinvestment is significant and positively associated with one-year ahead stock price crash risk. For instance, the marginal effect of overinvestment is 0.006 and statistically significant ($p<0.05$) in models (2) and (4). Furthermore, the marginal effect of overinvestment becomes stronger with the inclusion of Firm Fixed Effects. Specifically, the overinvestment is 0.009 and 0.008 and statistically significant ($p<0.1$) in the models (6) and (8), respectively. Regarding the market-related variables, models (3) and (4) show that Stock Return and Dturn are significantly and positively associated with one-year ahead stock price crash risk, consistent with Chen, Hong, and Stein (2001). Remarkably, the marginal effects of the market-related variables are higher compared to the marginal effects of the channels. For instance, the marginal effect of Stock Return and Dturn is 0.013 and 0.009, respectively, in model (4), while the marginal effect of overinvestment is only 0.006. This comparison is more pronounced in model

(8), where the marginal effect of Stock Return and Dturn becomes 0.032 and 0.014, respectively, but the marginal effect of overinvestment is only 0.008.

**[Insert Table 1.2, here]**

To check the robustness of findings with regards to the crash risk measure, OLS regression analysis is performed using the negative coefficient of skewness (NCSKEW) as dependent variable. NCSKEW is an alternative continuous measure of stock price crashes. These results are reported in Table 1.3. Models (1) to (4) include Year and FF12 Industry Fixed Effects, while models (5) to (8) include Year and Firm Fixed Effects. Panel A shows the results based on CRSP-Compustat while Panel B shows the results based on CRSP-Compustat-Execucomp. The results show that the opacity is significantly positive in the models (2) and (4) that include Year and FF12 Industry Fixed Effects, while it is insignificant in models (6) and (8) that include Year and Firm Fixed Effects. Regarding overinvestment, this is significantly positive in all model specifications. Stock Return is statistically insignificant whereas Dturn is significantly positive in all model specifications.

The same OLS analysis is conducted on CRSP-Compustat-Execucomp sample (1992-2018). The results, reported in Panel B of Table 1.3, are qualitatively similar with the results derived based on CRSP-Compustat. The only difference is that accounting opacity appears statistically insignificant in all model specifications now. The remaining results remain unchanged in all qualitative aspects. With regards to overinvestment, a significant and positive association with one-year ahead stock price crash risk is observed, while both the magnitude and the significance become weaker after the inclusion of Firm Fixed Effects. Regarding the market-related variables, only Dturn contributes significantly in explaining the movement of NCSKEW.

**[Insert Table 1.3, here]**

Finally, a subsample analysis is conducted. Specifically, in order to serve the purpose of study's investigation, the attention is turned on the CRSP-Compustat-Execucomp post SOX period (i.e. 2003-2018). This approach enables the investigation of the survival of the stock price crash channels, after the new regulation regime, which was mainly intended to mitigate agency problems. Table 1.4, Panel A reports the results when CRASH is the dependent variable, and Panel B reports the results when NCSKEW is the dependent variable. The results demonstrated in Table 1.4 lend credence to the findings

observed in the univariate analysis. As expected, in the post SOX period, both opacity and overinvestment appear insignificant in all model specifications. This evidence consists an indication that the agency view in recent years, when crash incidence is heightened, does not seem to offer an explanation for the increased stock price crash occurrences.

**[Insert Table 1.4, here]**

# 5 Potential explanations

The most prevalent explanation proposed by the literature so far, i.e. the agency theory explanation of the occurrence of stock price crashes, does not seem to be able to explain the phenomenon observed empirically. The explanation behind the stock price crash puzzle remains undetermined. The section further assesses numerous reasons why the stock price crash puzzle exists.

Nevertheless, the stock price crash puzzle exists, and it is prevalent even if different thresholds are used to define the crash week. Hutton, Marcus, and Tehranian (2009) have chosen the 3.09 threshold to generate a 0.1% percent of crashes in the normal distribution of firm-specific weekly returns. Consistent with their study in which they observed 17.1% of the firm-years in their sample experiencing one or more crash weeks, this study also ends up with a much higher frequency that experiences an upward trend, as time wears on. More specifically, while the percentage of crashed years in 1962 was 6.5%, in 2018 is 30%. However, this evidence is consistent with prior literature suggesting negative skewness in returns (Chen, Hong, and Stein, 2001) and reveals the weakness of the measure to capture what was intended to, an extreme event. And even if the measures are estimated by using different thresholds, the trend is exactly the same, with the only difference that the incidence is getting lower as threshold increases. Nevertheless, the overall increasing trend exists; the percentage of crash weeks has been more than quadrupled from 1962 to 2018, i.e. the stock price crash puzzle remains unexplained.

Seeking for alternative explanations, the study focuses on financial incentives provided to CEOs through their compensation packages, since it is a mean to align the interests between managers and shareholders and accordingly mitigate agency problems. Additionally, the characteristics of the market microstructure are considered, aiming to incorporate in the analysis the financial market viewpoint of interpretation. Apparently, such a financial market viewpoint assessment is challenging to be performed, since there

may be many reasons that may have an explanatory power on the observed phenomenon and this viewpoint remains largely unexplored. Nevertheless, a few supplementary results shed some light on the stock price crash puzzle and thus the plausibility of the explanations.

## 5.1 CEO compensation/incentives

In the course of the stock price crash puzzle investigation, CEO compensation components and incentives play an important role. The compensation packages are broadly used as mechanisms to mitigate agency problems in public firms through aligning the interests of managers and shareholders. Accordingly, Figure 1.8 illustrates the average value of CEO compensation components and incentives for the intersection of CRSP, Compustat and Execucomp. A significant increase in the total average compensation (Figure 1.8a) is observed across time. However, not all total compensation components grow in the same fashion. Specifically, in Figure 1.8b, 1.8c and 1.8d the percentages of the average salary (Figure 1.8b), the average bonus (Figure 1.8c) and the average option holdings (Figure 1.8d) have experienced a decrease from 28% to 12%, from 17% to 2% and from 3.5% to 1.5% in 2018, respectively. On the other hand, the component that experiences a significant increase, is the average percentage of stock holdings which has grown from 8% to 50% across the sample time period (Figure 1.8e). Additionally, the increase is not only prevailing in the average total compensation, but also relatively to the rest highly paid top executives. Specifically, the average percentage of the total compensation of the top five executives that goes to the CEO has also increased from 35% to 41% (Figure 1.8f). Finally, while the average CEO option holdings incentives ratio remains stable during the last years of the sample (Figure 1.8h), CEO stock holdings incentives ratio has raised (Figure 1.8g). This increase was expected given that the stock holdings have experienced a huge increase, from 8% to 50%, across time. Overall, this evidence is the only element that may be associated with the observed high crash probability. Prior stock price crash research by Kim, Li and Zhang (2011) investigated the relationship between top executives' equity incentives and stock price crash risk and found a weak positive relation between CEOs' incentives and stock price crash risk. Additionally, Andreou, Antoniou, Hutton, and Louca (2016) evidence that CEO stock option incentives increase stock price crash risk. Although it is difficult to arrive at any conclusion, it is controversial whether the increase of stock holdings and incentives in

accordance, indeed acted as a way to overcome the managerial risk aversion problem and induce optimal risk taking (Guay, 1999) or the unreasonably high amount resulted in "dis-incentives" (Benmelech, Kandel and Veronesi, 2010) and lead managers to make decision to the detriment of shareholders' welfare.

**[Insert Figure 1.8, here]**

Admittedly, earnings are important to managers since either they directly affect their compensation, or they are indirectly related with the level of stock prices. For instance, Graham, Harvey, and Rajgopal (2005) provide the belief that earnings are "the most important financial metric to external constituents." However, the direct manipulation of earnings is getting harder with the establishment of regulations that make managers accountable for their firms' disclosures, such as SOX. In the same vein, misuse of free cash flows by engaging in overinvestment can also be revealed from accounting information disclosed in financial statements. Accordingly, as time passes, it is more likely that managers no longer hold negative information through opacity or overinvestment, consistent with the empirical findings. Therefore, it is probable that they may seek for alternative channels through which they may retain or even inflate investors' expectations and subsequently the unsustainably high level of stock prices. Taken together, the empirical evidence suggests that while compensation practices are intended to mitigate some types of agency costs, these similar practices may encourage other forms of opportunistic behavior. For instance, there is evidence suggesting that compensation generates opportunistic incentives for managers to manipulate the timing of announcement of both good and bad news to the market (Baker, Collins, and Reitenga, 2003; Aboody and Kasznik, 2000). A combination of managerial incentives and economics of expectation may consist a potential alternative explanation. Recent regulatory changes are likely to further increase the importance of shaping investors' expectations. In addition to addressing the concerns of policymakers, the enacted Dodd-Frank Wall Street Reform and Consumer Protection Act (2010) entails public firms to submit the consent of executive compensation to a shareholder non-binding vote, at least once every three years. By enacting this legislation, shareholders are given the "say-on-pay" right to criticize any "Golden Parachute" compensation to executives. Accordingly, the pressure on management is amplified and the perception of shareholders regarding their reputation and ability is even more important. In this spirit, empirical evidence suggests that managers report positive firm news before the annual shareholder meetings,

whereby shareholders are expressing their concerns about firms' performance (Dimitrov and Jain, 2011). This pressure is even higher for highly paid underperforming managers that are expected to justify the "pay without performance" as per Bebchuk and Fried (2004). Therefore, their incentives to report positive news before the annual shareholder meetings are substantially higher. Likewise, managers aiming to shelter the component of firm performance which directly affects their financial rewards, i.e. the stock price level, may exploit information asymmetry. However, they may exploit information asymmetry to manifest self-interested behavior, but instead of concealing negative information, they may exploit the desire of investors to acquire more firm-specific information to shape their expectations about the firms' outcomes. As a result, under the opportunistic explanation, managers are expected to provide "fluff" news to obfuscate information regarding future performance prospects (e.g. Merkley, 2014). Likewise, managers might be engaging in "cheap talk", i.e. misrepresenting the firms' prospects with the intention of maximizing the short-term value (Balvers, Gaski, and McDonald, 2016) considering the managerial incentives from a value-seeking perspective. Insights drawn from aforementioned literature are supplemented with those from evidence provided by Bushee, Taylor, and Zhu (2020) suggesting that managers may issue voluntary stock-price increasing pre-conference disclosure, which suddenly result in inflated prices, and then benefit from the level of stock price by selling their shares. This accentuates the realization that personal rewards incentivize managers to exploit the heightened visibility, publicity and attention associated with the social-setting of conferences (Bushee, Jung, and Miller, 2011) and manifest their opportunistic behavior by "hyping" the stock to achieve their personal trading outcomes. At the same time, the easy and usually costless access to global information, enable firms to utilize all the available communication means to convey such type of positive-promising news via articles, media newswires, and press releases, the content of which mainly consist of qualitative information rather than numerical content. Therefore, even if none of the "expected" stories come true, the manager cannot be legally responsible/exposed to legal consequences for disorientating the investment community.

## 5.2 Market microstructure

Next, the study examines whether market frictions are able to explain the crash risk puzzle. In this line, Figure 1.9a displays the average trading volume which experienced a

huge increase during the last years of the sample. Also Figures 1.9b shows a declining percentage of firms listed in NYSE-Amex stock exchange, both in quantity and market capitalization. After Nasdaq's establishment (in 1971), the percentage of firms listed in NYSE-Amex declined from almost 75% to 40%, with a market capitalization ending up at 55% in 2018 (Figure 1.9c). Interestingly, the percentage of firms listed in Nasdaq has grown from 25% to 60% (Figure 1.9d), with a market capitalization reaching almost 45% in 2018 (Figure 1.9e). Over the years, it seems that Nasdaq became the focal point of investment activity.

**[Insert Figure 1.9, here]**

A closer look at the characteristics of Nasdaq Stock Market may shed light on the stock price crash puzzle. The Nasdaq Stock Market, established in 1971, was the first electronic stock exchange market. The reason for its establishment was to promote the over-the-counter securities, that used to be generally unused by many stock players, up to that point. Nasdaq stock exchange mainly consists of technology stocks and promising companies that vary significantly in terms of their stock prices. It keeps on being US's prevalent market in an era where technology is still considered as a way into the future. However, firms dealing with technological development are associated with many uncertainties, especially in terms of their future technological prospects (Gao, Porter, Wang, Fang, Zhang, Ma, Wang, and Huang, 2013), raising challenges in making accurate forecasts. A framework developed by Gartner Inc, namely "hype cycle model", offers an explanation on the path a technology experiences across time, regarding the expectation of the technological value. The model recommends that technologies progress through consecutive stages, starting with an overestimation of the value, succeeded by the disappointment and the recovery of expectations (Fenn and Raskino, 2008).

Additionally, in the recent era of electronics, individuals tend to develop, at least a basic, understanding in the concepts and tools of communication technology. Accordingly, the majority of people have an easy and usually costless access to various type of global information that are available to them and ready to be assessed and interpreted. The pre-mentioned "hype cycle model", accompanied with the easy access to information, enable firms to utilize all the means that are in their hands, to convey any arguments that could support the formation of a firm's positive image. At this point, it is worthy to mention the pivotal phrase of Shiller (2000), who questioned the high levels of market, "Their behavior is heavily influenced by news media that are interested in attracting viewers or

readers, with little incentive to report regularly on quantitative analysis that might give a correct impression of the aggregate stock market level." Accordingly, the transmission of any positive news that are not justified by the associated positive changes in the firms' fundamentals, could "hype" inflated investors' expectations. Finally, when the expectations could not be met, the investors may become extremely disappointed and reverse the unsustainably high levels of stock prices, by triggering the stock price crashes. This concept could also be related to the disappointment aversion framework, in which investors have the feeling of disappointment for any outcomes that are below their "predetermined" expected outcome. In such cases, there is evidence suggesting that the investors' reaction to disappointments may lead them to restructure their portfolio by reducing their exposure to stock market (Xie, Pantelous, and Florackis, 2016).

## 5.3 Irrational Exuberance

Seminal contributions have been made in asset pricing studies, signifying the role for psychological factors such as "irrational exuberance" (Shiller, 2000), "mania" (Ofek and Richardson, 2003), "animal spirits" (Akerlof and Shiller, 2010), and "sentiment" (Baker and Wurgler, 2006). More specifically, the preceding studies have recognized the deviation of the decisions performed by the market participants from pure rationality. They proposed the linkage of the psychological factors with the level of the market and incorporate them in their research efforts to provide an explanation on bubbles and crashes.

A number of authors in the field of behavioral finance have documented that stock market characteristics resembles the speculative bubble, i.e. a condition where the enthusiasm of investment community drive the stock prices at high levels. The irrational exuberance is the psychological basis of speculative bubble. Irrational exuberance is a weaker emotional state compared to euphoria or madness, that does not involve this "crazy" element. It is a notion closer to a misinterpretation driving by enthusiasm, such as bad judgment which derives from ignoring or partially understanding what we want to understand. In the light of reported conclusions, Shiller (2000) acknowledged irrational exuberance as a representative term to describe the market level. In this context, he urges researchers to enhance their investigations by testing them against the "impressive evidence" that proposes that the level of stock prices do not just reflect the total available economic information, as rationality assumes. Furthermore, as Shiller mentioned, individual

investors do not completely realize that the level of stock prices is determined by a group of individual investors, whose thinking process and information interpretation process may be extremely similar as their own. Therefore, the individual investors overestimate the ability of "sophisticated" institutional investors to set the prices and underestimate their own impact on the level of the market, the impact of "animal spirits".

While this potential explanation of crashes is interrelated with the explanation presented in the previous point, i.e. "hype" inflated investors' expectations, at this point the focus is on the investors' point of view. This explanation highlights, even more, the need to consider the financial market side. We all need to remember that prices are set by the joint behavior of the market participants. Accordingly, if the market participants fail to justify their choices by fundamental values, and let their enthusiasm to drive them, it is inevitable that bubbles and subsequently crashes will occur, i.e. where the prices will primarily grow more than they should, for extended periods and then the revision of the investors' expectations will drive them suddenly down, respectively. Additionally, the electronic era, can notoriously inflate the problem scope, since available news may spur faster and to a greater extent the investor's enthusiasm. By approaching the explanation from the investor's point of view and suggesting irrational exuberance term to describe the market level, the responsibility is mainly assigned to the investors. The individual investors inflate their own expectations by seeking for information that confirms their positive beliefs and their effort can be achieved easier in the most recent years by having access to different sources of gathering information.

# 6 Conclusion

This study conducts empirical investigation demonstrating that the occurrence of stock price crashes for the average US-listed firm has steadily grown from 5.5% in 1950 to 27% in 2018 for the CRSP universe. This up-trending tendency is similarly observed for the CRSP-Compustat and CRSP-Compustat-Execucomp data sets, which are widely being under investigation in the crash risk literature. This, neither sample nor industry specific, phenomenon gives birth to the stock price crash puzzle.

The most prevalent explanations derived from the agency theory arguments, accentuate financial reporting opacity and overinvestment as the channels underpinning the relationship between the hoarding of bad news and stock price crashes. Assessing this stylized fact from the agency theory viewpoint, the intensifying occurrences of stock price

crashes could have been ascribed to the trend of the two dominant channels that managers exploit to manifest their self-interested strategies. Conversely, this study provides compelling empirical evidence suggesting that these prominent agency-based channels offer a limited role in explaining the up-trending occurrences of stock price crashes as observed for the average US-listed firm.

In addition, a noteworthy improvement is observed regarding several important corporate governance mechanisms, indicating an enhancement in the monitoring and discipline process. Furthermore, the results derived from the multivariate analysis conducted, support the graphical findings. Specifically, this study provides empirical evidence suggesting that especially when using the post SOX sample, the agency-based channels offer a limited role in explaining the up-trending occurrences of stock price crashes as observed for the average US-listed firm. Further multivariate analyses demonstrate that after controlling for the firm's financial characteristics and after removing both the firm's average crash risk effect (firm fixed effects) over the entire estimation period and any time-series pattern in overall crash risk (time fixed effects), any statistical relationship for either of the agency-based channels disappears.

Collectively, this evidence lends little credence to an agency-based explanation of the phenomenon. While crashes are more prevalent as time passes, the average US-listed firm appears more transparent, overinvest less and seems to have better corporate governance. Taken together, not only the findings derived from the empirical evidence, but also the upsurge of corporate governance regulation and standards aiming to combat managerial opportunism, agency problems seem to have attenuated. Accordingly, the agency viewpoint does not seem to be an explanation; specifically, the agency-based channels, opacity and overinvestment, cannot reconcile the empirical evidence. This study offers discussion of various routes that future research can seek answers to rationalize the stock price crash puzzle. Seeking to expand the stock price crash literature by offering some critical perspective in order to highlight alternative views in explaining the up-trending occurrences of stock price crashes. Overall, this study brings to the surface the stock price crash puzzle which remains elusive and the mechanisms of its origin need to be further explored.

# 7 Appendix-Chapter 1

**Variable Definitions**

| Variable | Definition |
|---|---|
| **Panel A:** Crash risk measures | |
| CRASH | An indicator variable set equal to one if a firm experiences one or more crash weeks during a fiscal year, and zero otherwise.<br><br>A "crash week" is, when the firm-specific weekly returns fall at least 3.09 standard deviations below the average firm-specific weekly return value during the fiscal year. For any firm in the sample, the firm-specific weekly return is estimated as $W_{j,w} = \ln[1 + e_w]$, where $e_w$ is the residual from the following equation:<br><br>$$r_w = a + b_1 r_{m,w-2} + b_2 r_{m,w-1} + b_3 r_{m,w} + b_4 r_{m,w+1} + b_5 r_{m,w+2} + b_6 r_{i,w-2} + b_7 r_{i,w-1} + b_8 r_{i,w} + b_9 r_{i,w+1} + b_{10} r_{i,w+2} + e_w$$<br><br>where $r_{m,w}$ is the value-weighted market return in week *w* and $r_{i,w}$ is the Fama and French value-weighted industry return. |
| NCSKEW | The negative of the third moment of firm-specific weekly returns ($W_{j,w}$) divided by the standard deviation of firm-specific weekly returns raised to the third power. |
| DUVOL | The natural logarithm of the difference of the volatilities between the negative and positive firm-specific weekly returns ($W_{j,w}$). |
| **Panel B:** Channels of stock price crashes | |
| Opacity | Following Hutton, Marcus, and Tehranian (2009), opacity is measured as the prior three years' moving sum of the absolute value of discretionary accruals (*DACC*), where *DACC* is measured as follows:<br><br>$DACC_t = \frac{TA_t}{ASSETS_{t-1}} - (\widehat{a_0}\frac{1}{ASSETS_{t-1}} + \widehat{b_1}\frac{\Delta SALES_t - \Delta RECEIVABLES_t}{ASSETS_{t-1}} + \widehat{b_2}\frac{PPE_t}{ASSETS_{t-1}})$<br><br>where Total Accruals (TA) are estimated as income before extraordinary items, minus cash flow from operating activities adjusted for extraordinary items and discontinued operations and regressed on the following cross-sectional regression equation using the firms in each Fama and French 48 industries for each fiscal year:<br><br>$\frac{TA_t}{ASSETS_{t-1}} = a_o\frac{1}{ASSETS_{t-1}} + b_1\frac{\Delta SALES_t}{ASSETS_{t-1}} + b_2\frac{PPE_t}{ASSETS_{t-1}} + e_t$<br>where TA denotes total accruals, ASSETS denotes total assets, ΔSALES denotes change in sales, ΔRECEIVABLES denotes change in receivables and PPE denotes property, plant, and equipment. |
| Overinvestment | Overinvestment is measured as the prior three years' residuals from the following model:<br><br>$I_{NEWt} = a_o + b_1\frac{V_{AIP}}{MV}_{t-1} + b_2 LEVERAGE_{t-1} + b_3 CASH_{t-1} + b_4 AGE_{t-1} + b_5 SIZE_{t-1} + b_6 STOCK\ RETURN_{t-1} + b_7 I_{NEWt-1} + e_t$<br><br>where $V_{AIP}$ denotes the value of assets in place and is measured as:<br><br>$$V_{AIP} = (1 - ar)BV + (1 + r)OI - arD$$<br><br>where $BV$ is the book value given by common ordinary equity, $OI$ is the operating income after depreciation, $D$ is annual dividends, $r$=12% (Richardson, 2006) and $a = AEP/(1 + r - AEP)$ where AEP is the abnormal |

| | |
|---|---|
| | earnings persistence parameter from the Ohlson (1995) framework and equal 0.62, $MV$ is the market value of equity, $LEVERAGE$ is the sum of debt in current liabilities and long-term debt divided by book value of equity, $CASH$ is the balance of cash and short term investments deflated by total assets at the start of the year, $AGE$ is the natural logarithm of the number of years that the firm is covered in the Compustat universe, $SIZE$ is the natural logarithm of total assets at fiscal year-end and $STOCK\ RETURN$ is the stock returns for the year prior to the investment year.<br><br>$I_{NEW}$ is the difference between $I_{TOTAL}$ and $I_{MAINTENANCE}$ where $I_{TOTAL}$ denotes the total investment expenditure and is measured as the sum of capital expenditure, acquisition expenditure and research and development expenditure less cash receipts from sale of property, plant, and equipment and $I_{MAINTENANCE}$ denotes the investment expenditure necessary to maintain assets in place and is measured as the depreciation and amortization.<br><br>$I_{NEW}$ is decomposed into the expected investment expenditure in new positive NPV projects, and abnormal/unexpected investment. The abnormal/unexpected investment, which can be either negative/positive denotes the underinvestment/overinvestment. |
| **Panel C:** Firm characteristics | |
| Size | Total assets. |
| Firm Age | The number of years that the firm is covered in the Compustat universe. |
| Market to Book | The ratio of market value to book value of equity. |
| Leverage | The ratio of total liabilities to total assets. |
| Return on Equity | The ratio of income before extraordinary items to equity. |
| Return on Assets | The ratio of income before extraordinary items to total assets. |
| Market Capitalization | The market capitalization as computed by the multiplication of the market price of the stock by the number of shares outstanding. |
| Volume | The sum of the trading volumes as reported by CRSP database. |
| Dturn | The detrended average weekly stock trading volume during the fiscal year. |
| **Panel D:** Stock Exchange | |
| NYSE-Amex | An indicator variable set equal to one if the exchange code (as reported by Compustat) takes the value of 11 or 12. |
| Nasdaq | An indicator variable set equal to one if the exchange code (as reported by Compustat) takes the value of 14. |
| **Panel E:** External corporate governance | |
| Non-Transient Inst | The percentage of stock ownership in the firm by dedicated or quasi indexers institutional investors (following the classifications as in Bushee (1998)). |
| Transient Inst | The percentage of stock ownership in the firm by transient institutional investors (following the classifications as in Bushee (1998)). |
| HHI | The sum of the square market share of all the firms in an industry, where the market share refers to the sales of the firm over the total sales of all firms in each industry. |
| Auditor Tenure | Number of consecutive fiscal years that the auditor has been retained by the client, up to and including the current year (following Callen and Fang (2017)). |
| **Panel F:** Internal corporate governance | |
| Board Size | Total number of directors on the board. |
| Independent Directors | Number of independent directors divided by the board size. |
| Female Directors | Number of female directors divided by the board size. |
| Busy Directors | Number of directors who are also members of other Major Company Boards divided by the board size. |
| Not Attended Directors | Number of directors who attended less than 75% of the board meetings divided by the board size. |

| | |
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| CEO Duality | An indicator variable set equal to one if the CEO is also the Chairman of the board, and zero otherwise. |
| **Panel G:** CEO compensation/incentives | |
| Total Compensation | Total compensation for the individual year, comprised of the following: Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Total Value of Stock Options Granted (using Black-Scholes), Long-Term Incentive Payouts, and All Other Total. |
| Bonus | The ratio of the dollar value of a bonus (cash and non-cash) earned by the CEO during the fiscal year to total compensation. |
| Salary | The ratio of the dollar value of the base salary (cash and non-cash) earned by the CEO during the fiscal year to total compensation. |
| Stock Holdings | The ratio of the Total Value of Restricted Stock Granted during the fiscal year to total compensation. |
| Option Holdings | The ratio of the Total Value of Stock Options Granted (using Black-Scholes) during the fiscal year to total compensation. |
| CEO Pay Slice | The ratio of the total compensation to the top five executives that goes to the CEO. |
| Stock Incentives | The CEO stock holdings incentives ratio estimated as in Bergstresser and Philippon (2006). |
| Option Incentives | The CEO option holdings incentives ratio estimated as in Bergstresser and Philippon (2006). |

# 8 Figures-Chapter 1

**Figure 1. 1.** Time evolution of stock price crashes occurrences (dichotomous measure)

This figure depicts the frequencies of stock price crashes (CRASH) for: CRSP universe from 1950 to 2018, CRSP-Compustat universe from 1962 to 2018 and CRSP-Compustat-Execucomp universe from 1992 to 2018. The sample comprises of common stocks (*i.e.*, share codes 10 and 11) traded in NYSE, Amex or Nasdaq, with stock price greater than 1 USD at the end of fiscal year, and more than 26 weeks of stock returns in a fiscal year. The firm-specific returns are estimated using the market-industry model.

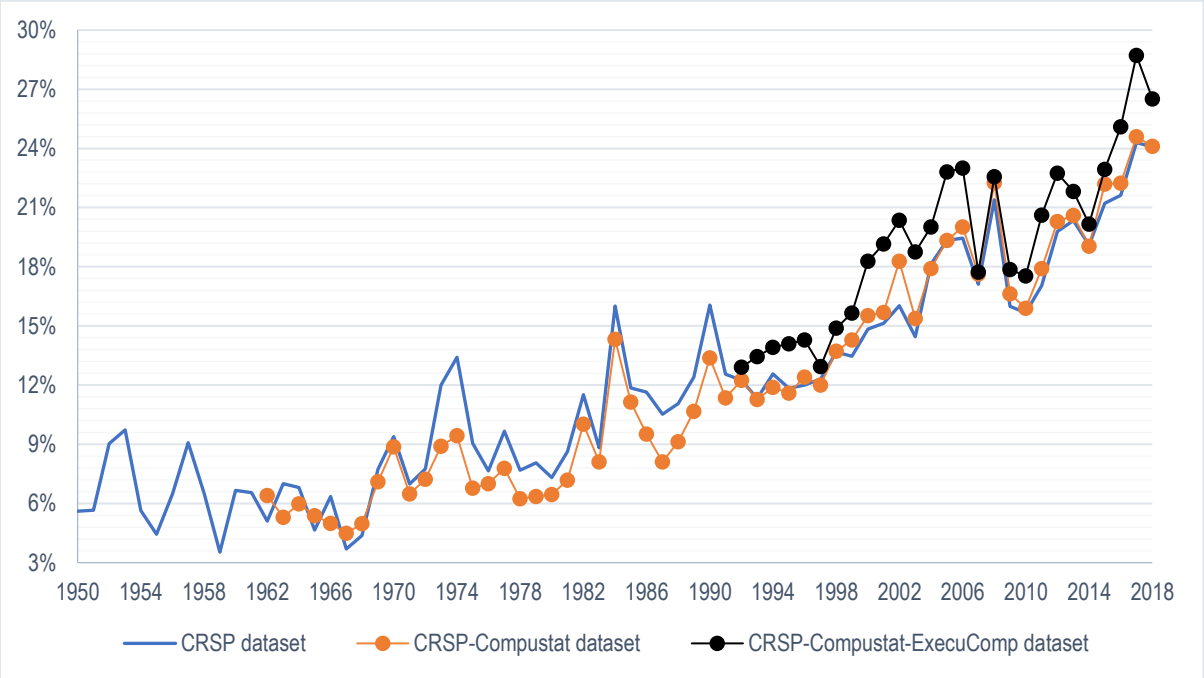


**Figure 1. 2.** Time evolution of stock price crashes occurrences (continuous measures)

This figure depicts the two continuous crash risk measures, namely, negative coefficient of skewness (NCSKEW) and down-to-up volatility (DUVOL) for: CRSP-Compustat universe from 1962 to 2018 and CRSP-Compustat-Execucomp universe from 1992 to 2018. The sample comprises of common stocks (*i.e.*, share codes 10 and 11) traded in NYSE, Amex or Nasdaq, with stock price greater than 1 USD at the end of fiscal year, and more than 26 weeks of stock returns in a fiscal year. The firm-specific returns are estimated using the market-industry model.

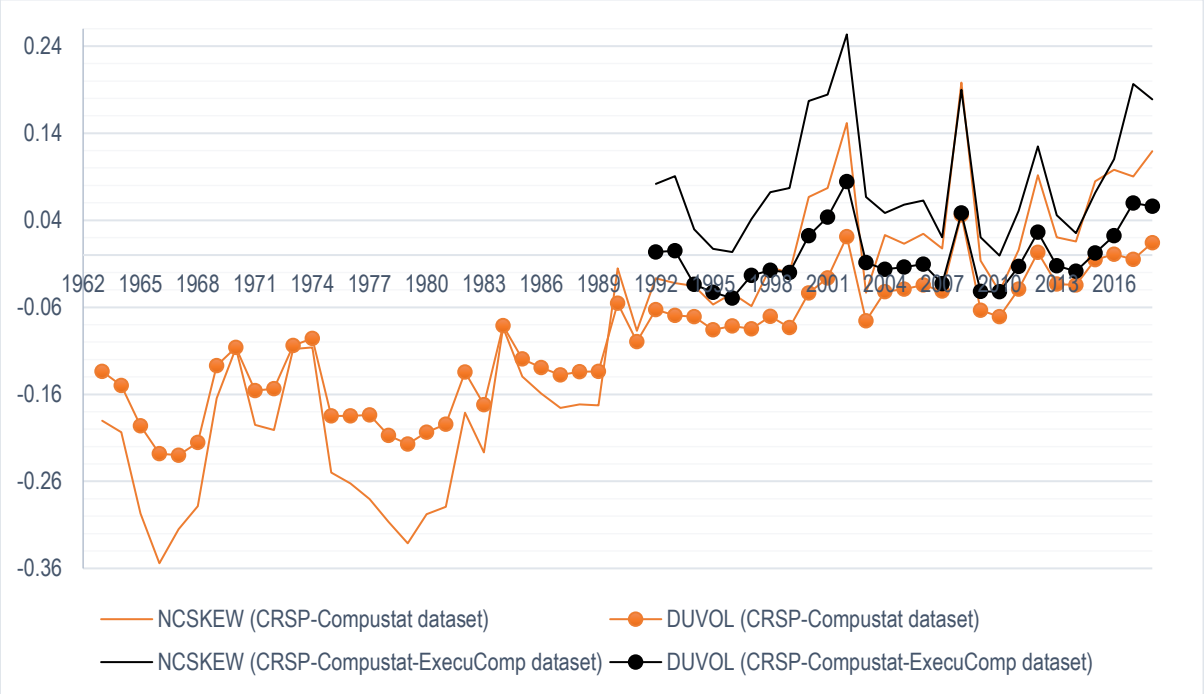
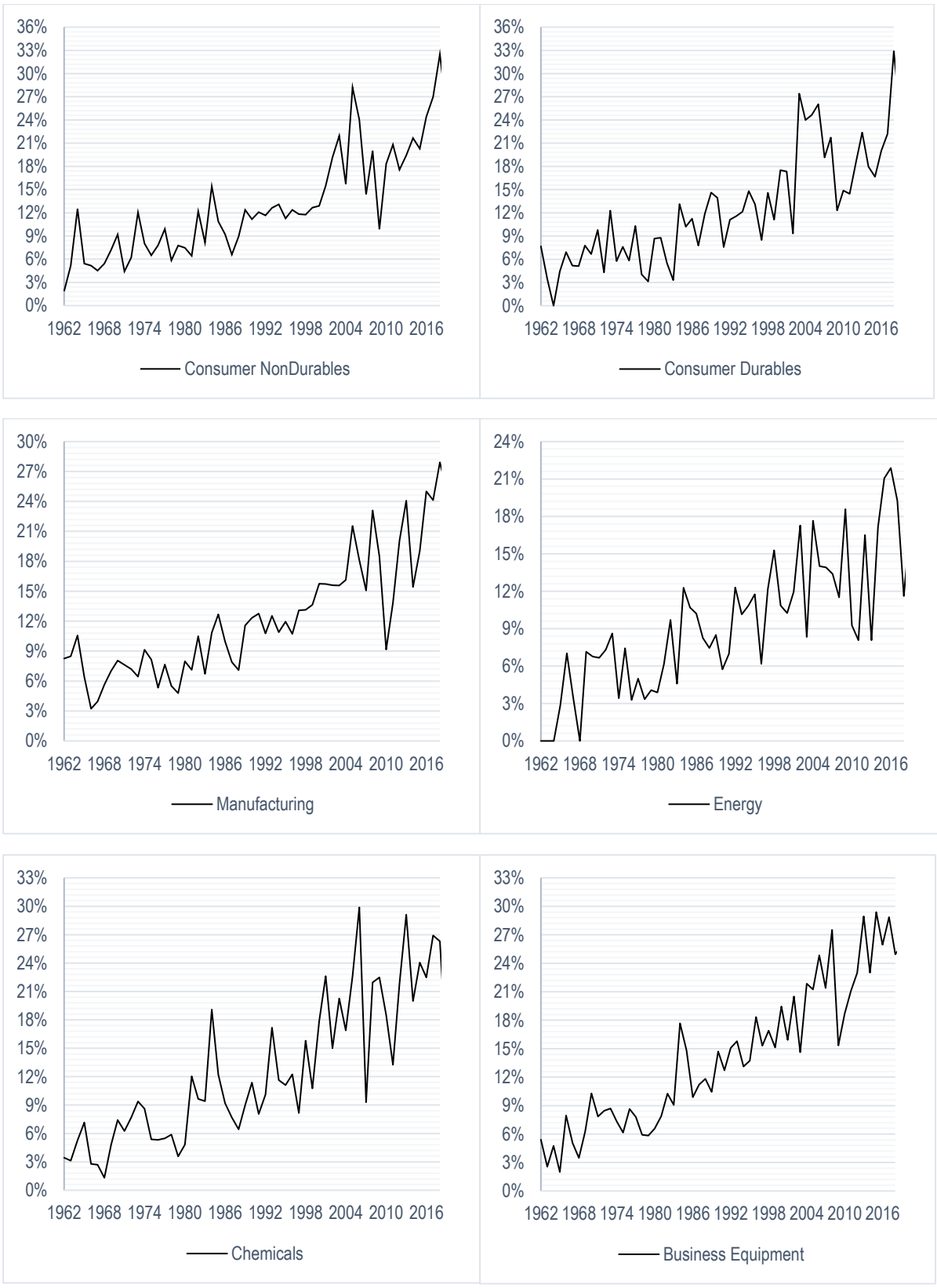
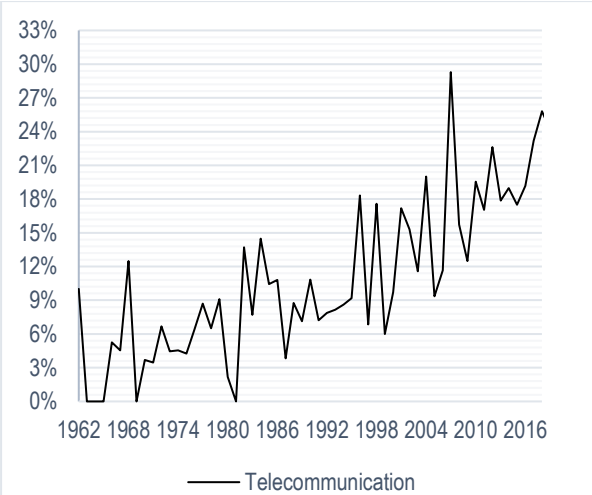


**Figure 1. 3. Frequencies of stock price crashes per Fama-French 12 Industry**

This figure illustrates the frequencies of stock price crashes per Fama-French 12 Industry, using the intersection of CRSP and Compustat for the period 1962 to 2018.

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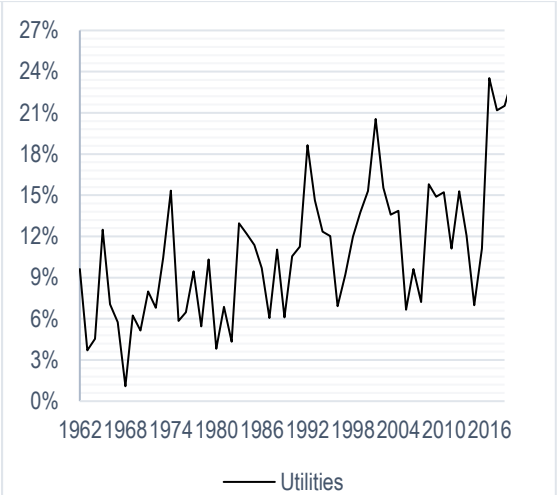
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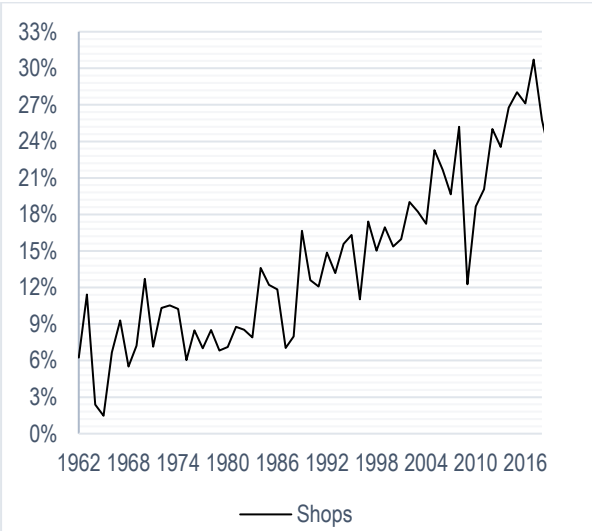
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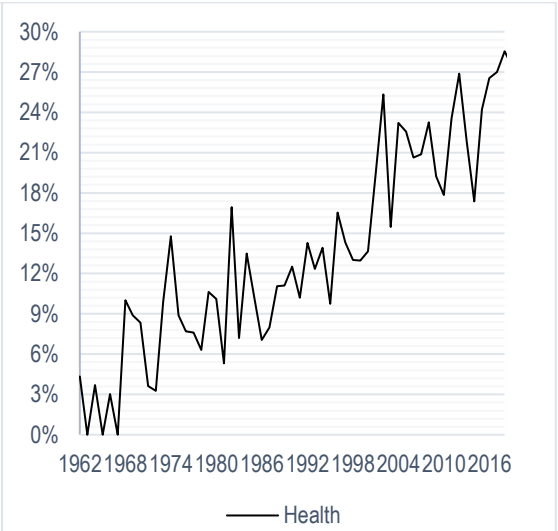
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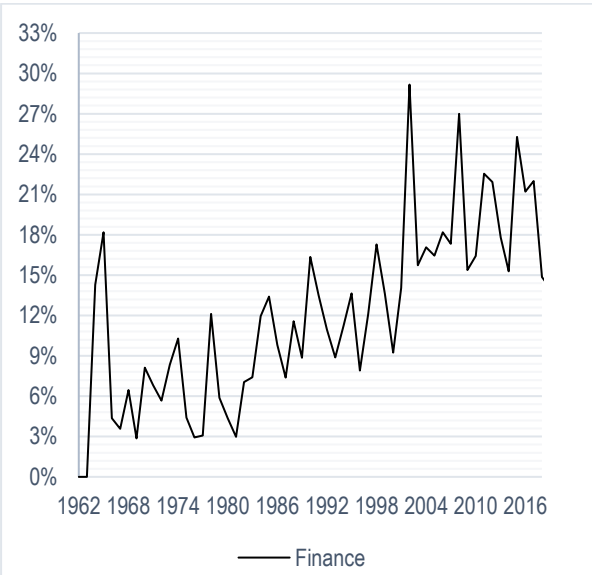
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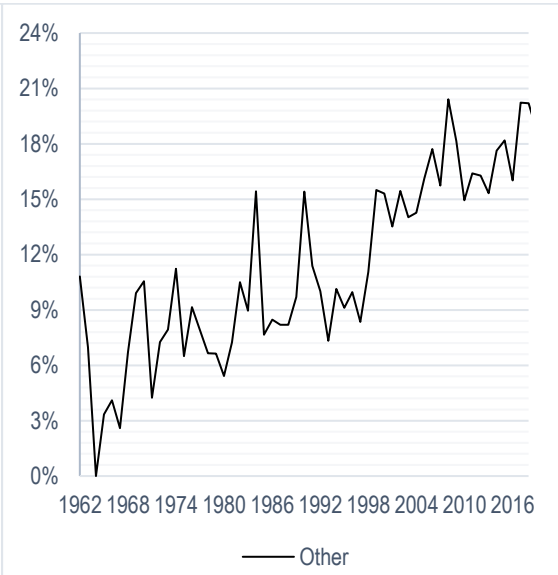
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**Figure 1. 4.** Time evolution of average value of opacity *vs* frequencies of stock price crashes

This figure depicts the average value of opacity (left axis) and the frequency of stock price crashes (right axis) for: CRSP-Compustat universe from 1974 to 2018 and CRSP-Compustat-Execucomp universe from 1992 to 2018.

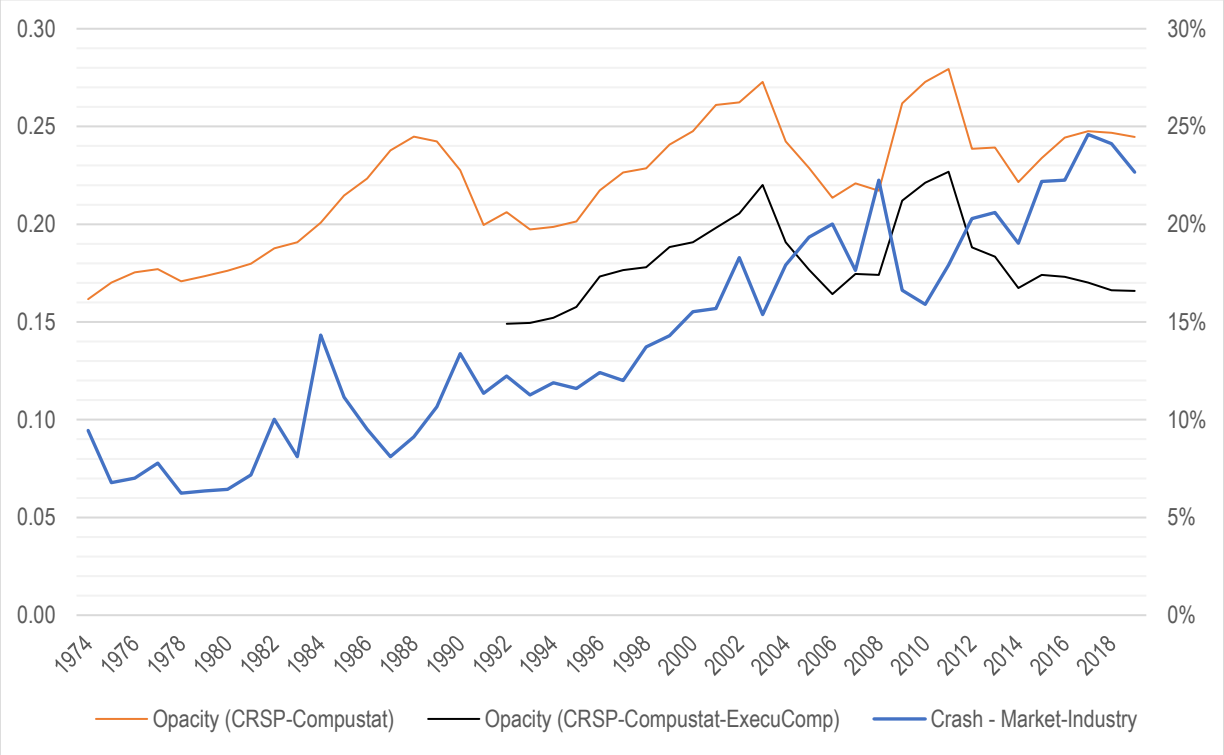


**Figure 1. 5.** Time evolution of average value of overinvestment *vs* frequencies of stock price crashes

This figure depicts the average value of overinvestment (left axis) and the frequency of stock price crashes (right axis) for: CRSP-Compustat universe from 1974 to 2018 and CRSP-Compustat-Execucomp universe from 1992 to 2018.

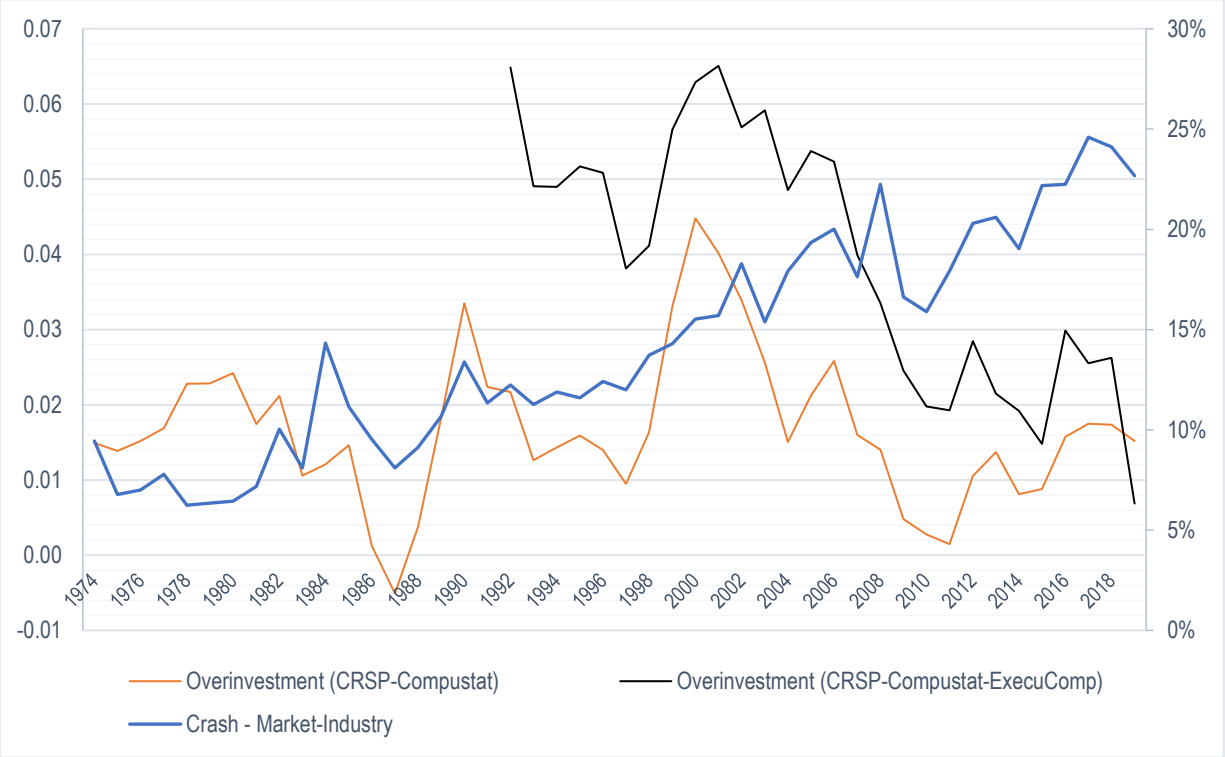


**Figure 1. 6.** Time evolution of average value of internal corporate governance functions

This figure depicts the average value of internal corporate governance functions (as indicated in each subfigure) for: CRSP-Compustat and CRSP-Compustat-Execucomp universe from 1996 to 2018. Detailed definitions of these variables are presented in each subfigure.

**Figure 1. 6a.** Average board size
Total number of directors on the board.

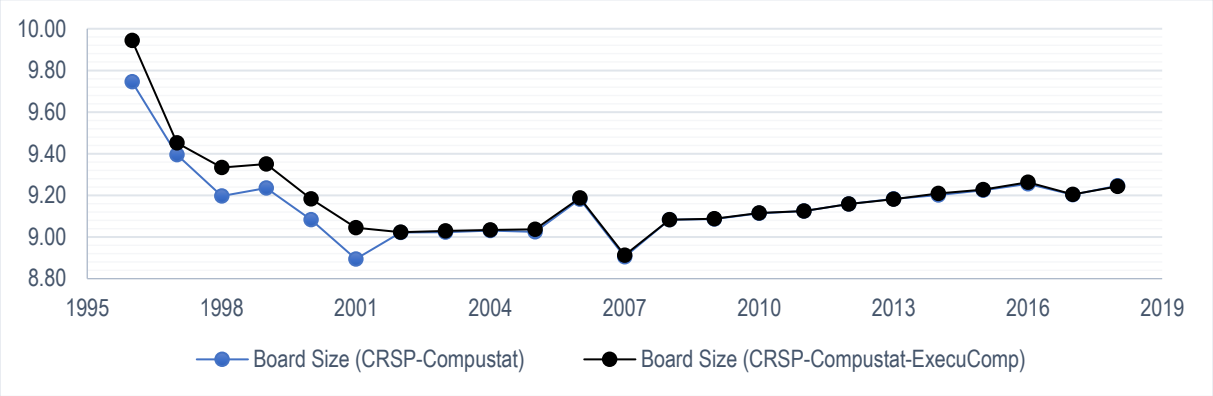



**Figure 1. 6b**. Average CEO duality
The percentage of CEOs who are also Chairpersons of their firms' board.

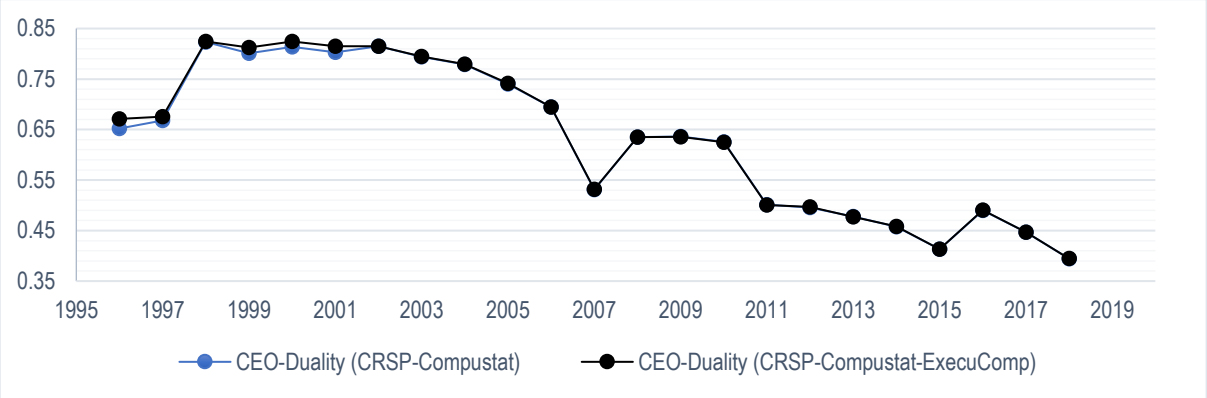



**Figure 1. 6c**. Average percentage of independent directors
The number of independent directors divided by the board size.

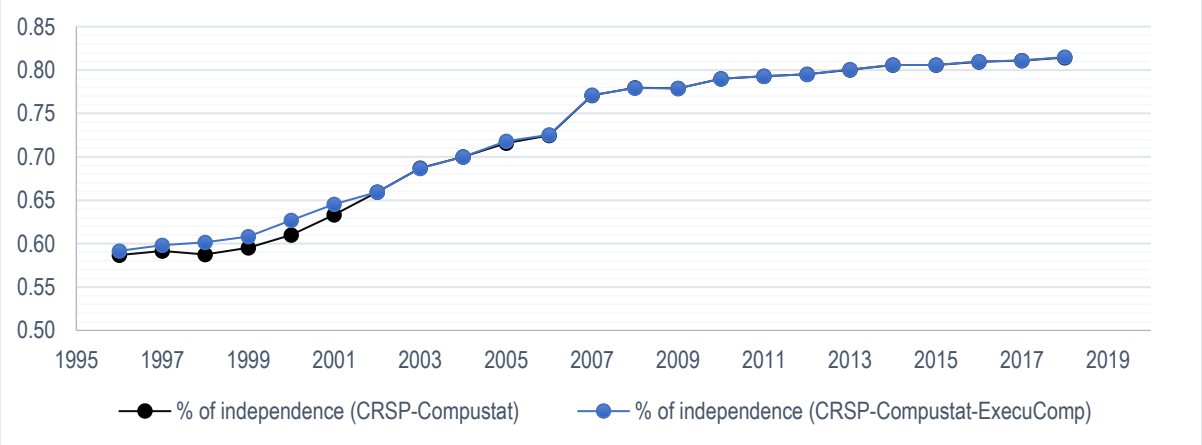


**Figure 1. 6d**. Average percentage of busy directors
The number of directors who are also members of other major company boards divided by the board size.

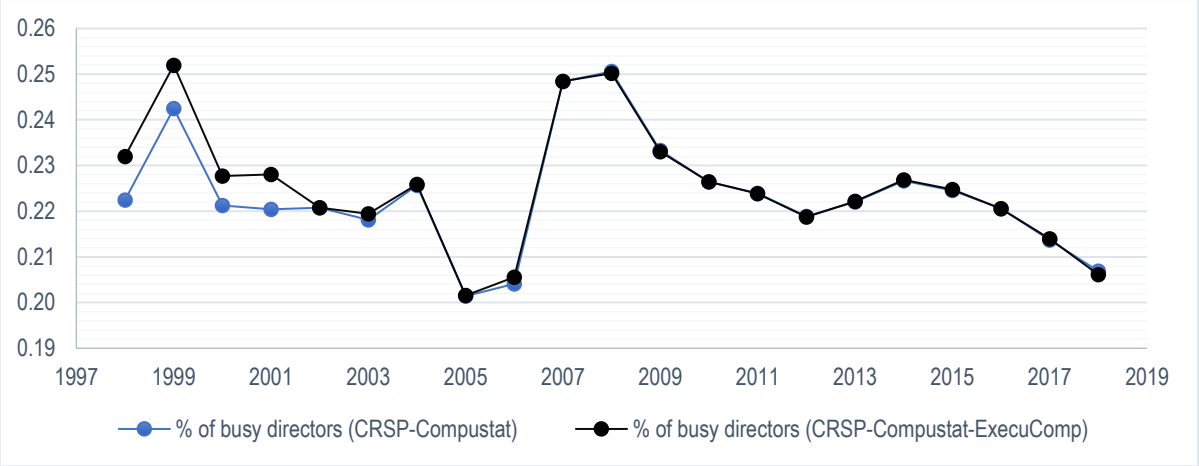



**Figure 1. 6e**. Average percentage of not attended directors
The number of directors who attended less than 75% of the board meetings divided by the board size.

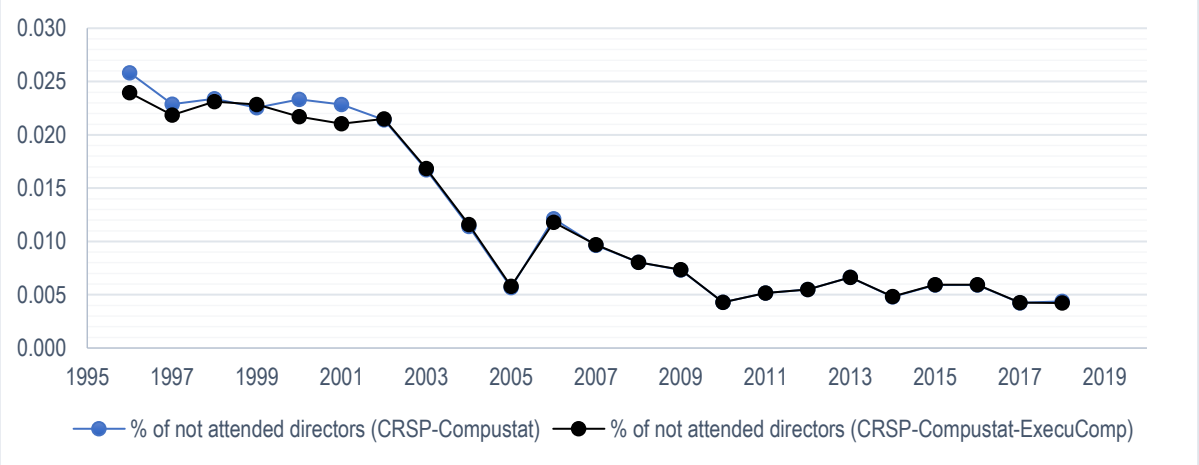



**Figure 1. 6f**. Average percentage of female directors
The number of female directors divided by the board size.

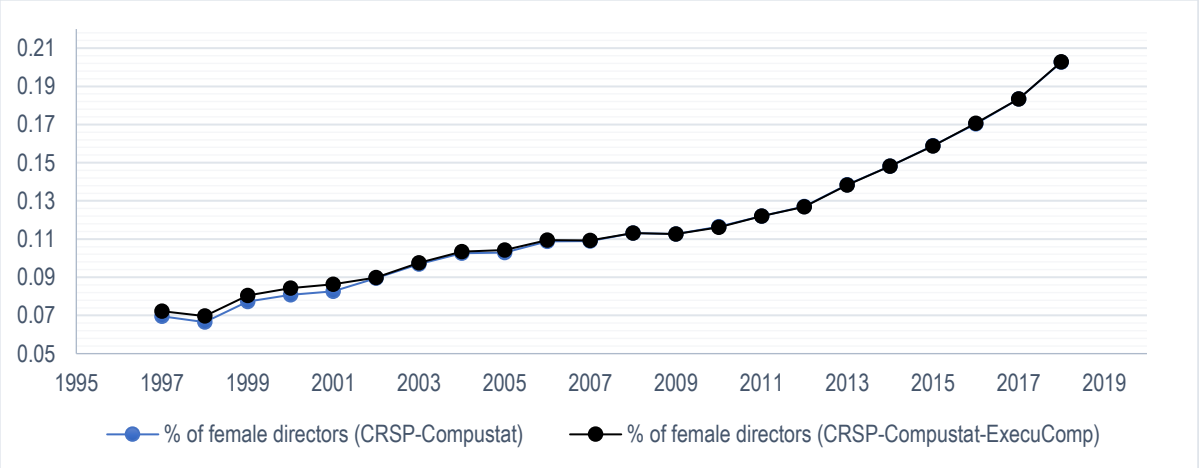


**Figure 1. 7.** Time evolution of average value of external corporate governance functions

This figure depicts the average value of external corporate governance functions (as indicated in each subfigure) for: CRSP-Compustat and CRSP-Compustat-Execucomp universe. The figure depicts the analysis from the earliest year for which sufficient data are available. Detailed definitions of these variables are presented in each subfigure.

**Figure 1. 7a**. Average percentage of transient institutional ownership
The percentage of stock ownership in the firm by transient (short-term) institutional investors.

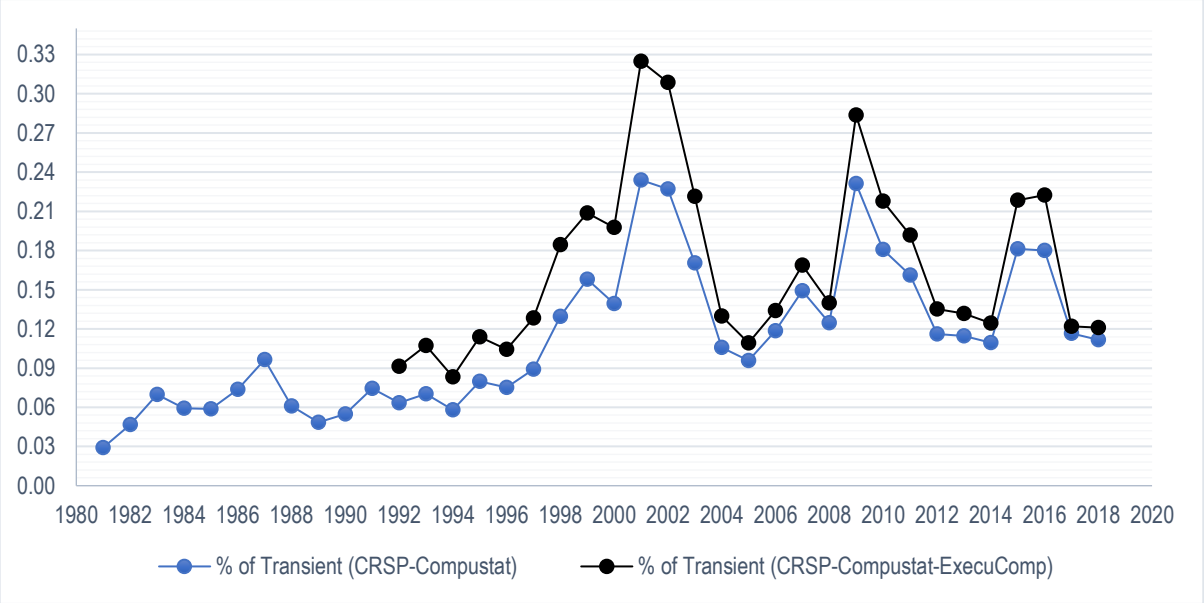



**Figure 1. 7b**. Average percentage of non-transient institutional ownership
The percentage of stock ownership in the firm by non-transient (dedicated or quasi-indexers) institutional investors.

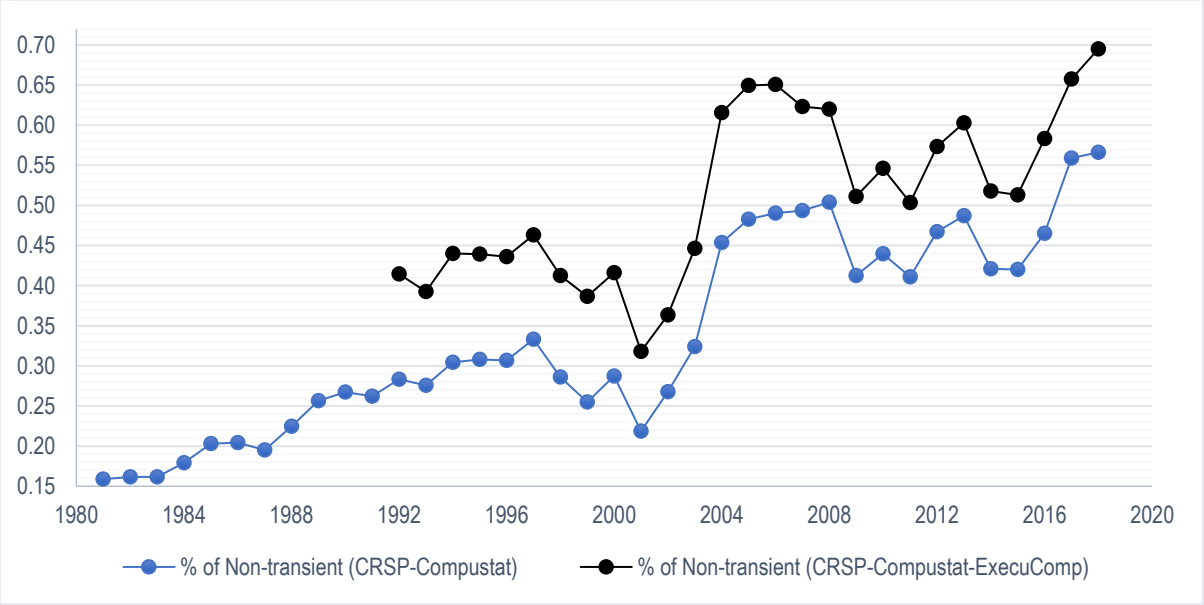


**Figure 1. 7c.** Average product market competition

The sum of the square market share of all the firms in an industry (where the market share refers to the sales of the firm over the total sales of all firms in each industry).

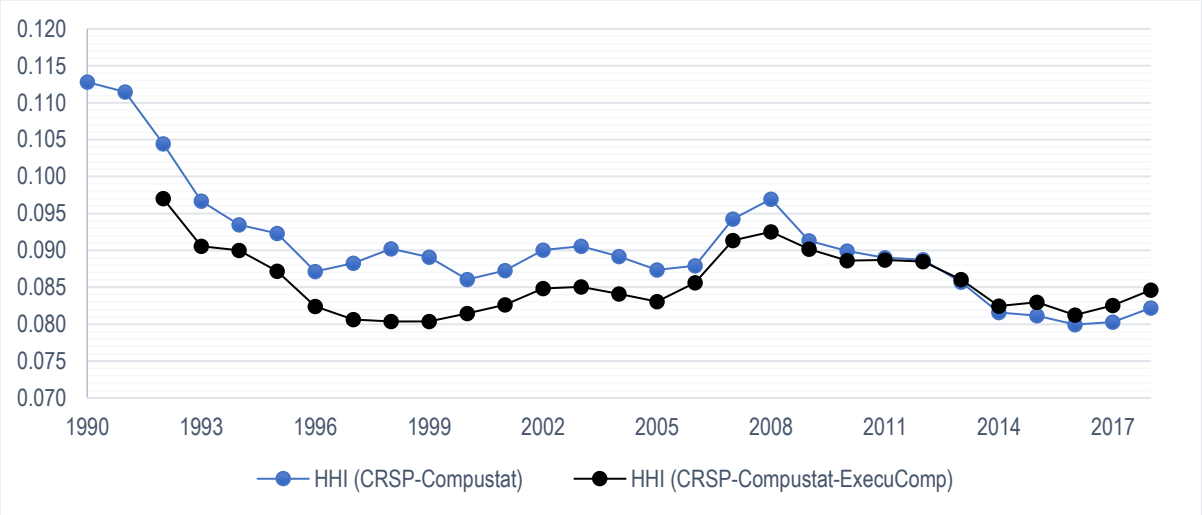



**Figure 1. 7d**. Average percentage of auditor tenure
The number of consecutive fiscal years that the auditor has been retained by the client.

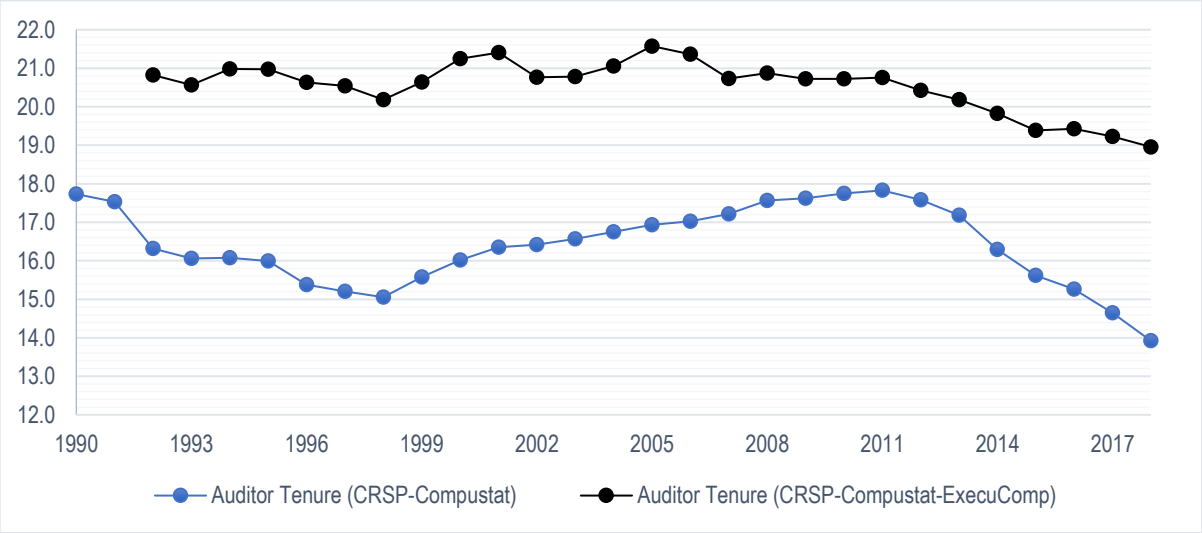


**Figure 1. 8.** Average value of CEO compensation components and incentives

This figure depicts the average value of CEO compensation components and incentives (as indicated in each subfigure) for CRSP-Compustat-Execucomp universe from 1992 to 2018. Detailed definitions of these variables are presented in each subfigure.

**Figure 1. 8a**. Average total compensation
Total compensation for the individual year, comprised of the following: Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Total Value of Stock Options Granted (using Black-Scholes), Long-Term Incentive Payouts, and All Other Total.

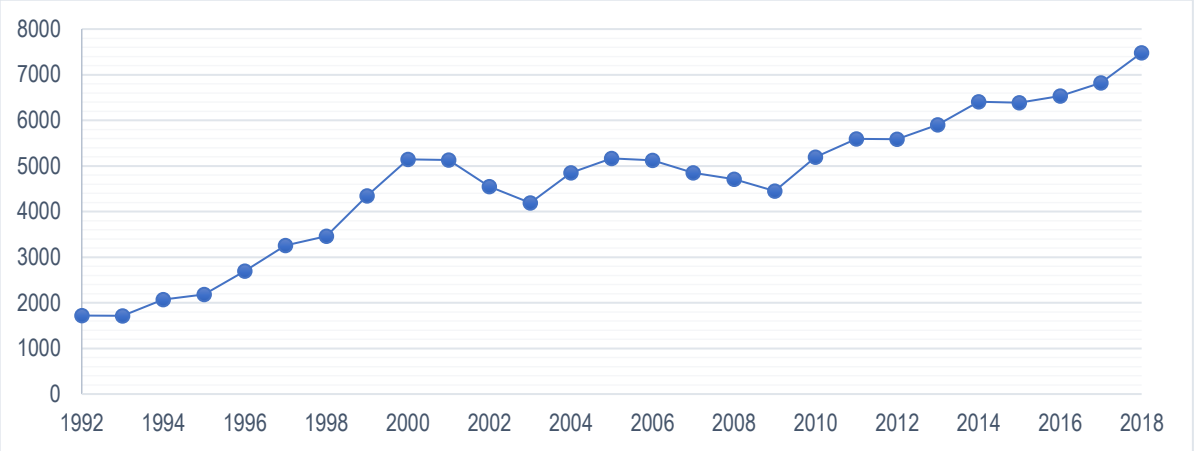



**Figure 1. 8b**. Average salary
The ratio of the dollar value of the base salary (cash and non-cash) earned by the CEO during the fiscal year to total compensation.

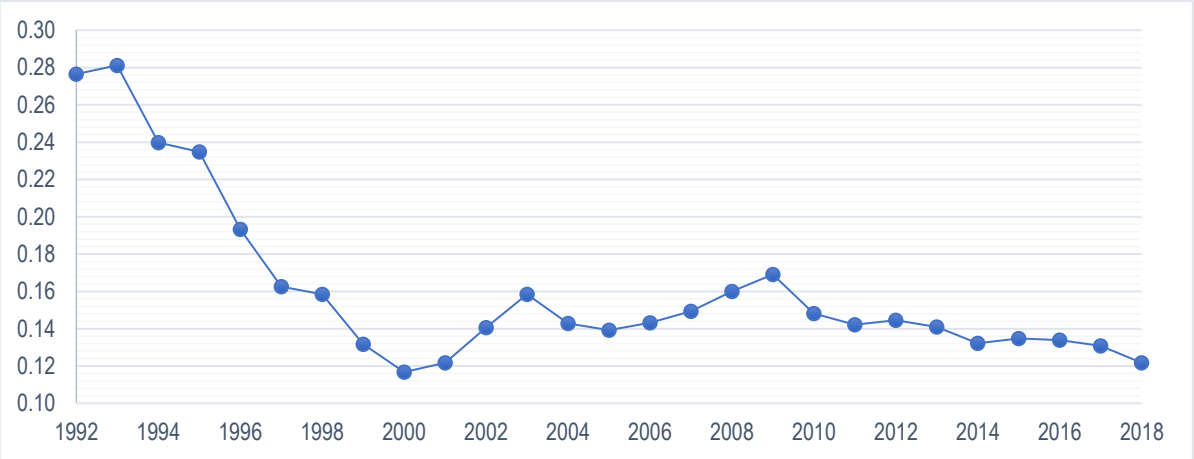


**Figure 1. 8c.** Average bonus
The ratio of the dollar value of a bonus (cash and non-cash) earned by the CEO during the fiscal year to total compensation.


**Figure 1. 8d**. Average option holdings
The ratio of the Total Value of Stock Options Granted (using Black-Scholes) during the fiscal year to total compensation.

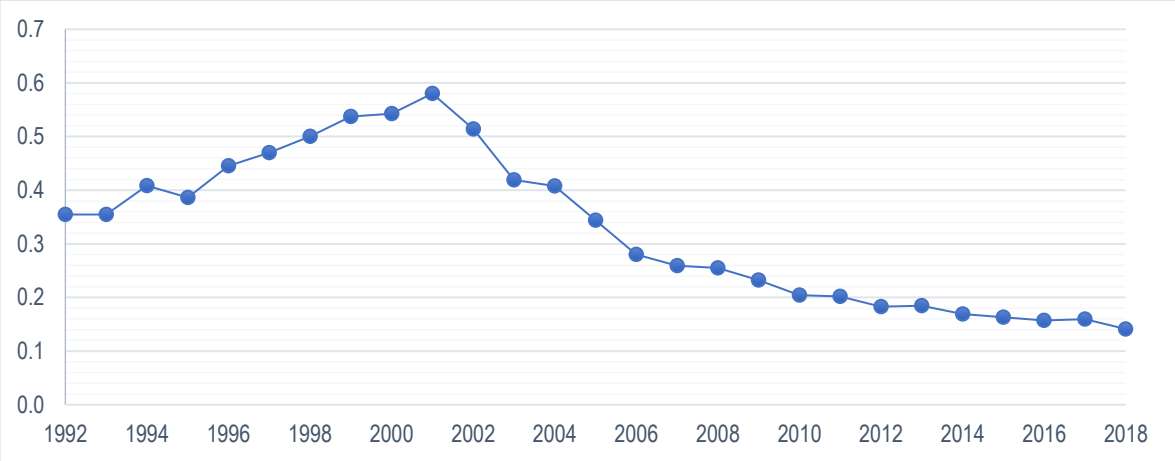


**Figure 1. 8e**. Average stock holdings
The ratio of the Total Value of Restricted Stock Granted during the fiscal year to total compensation.

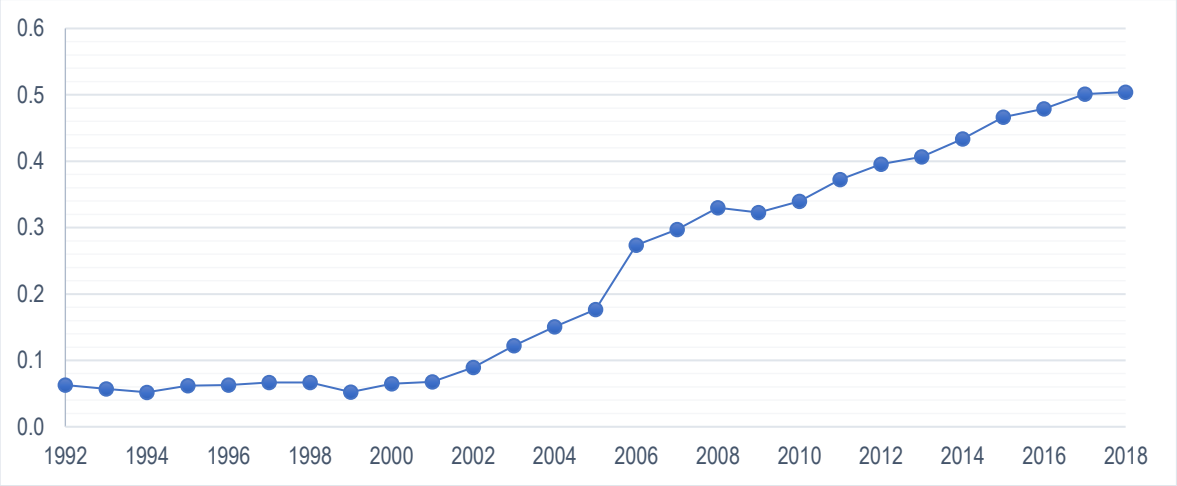



**Figure 1. 8f.** Average CEO pay slice
The ratio of the total compensation to the top five executives that goes to the CEO.

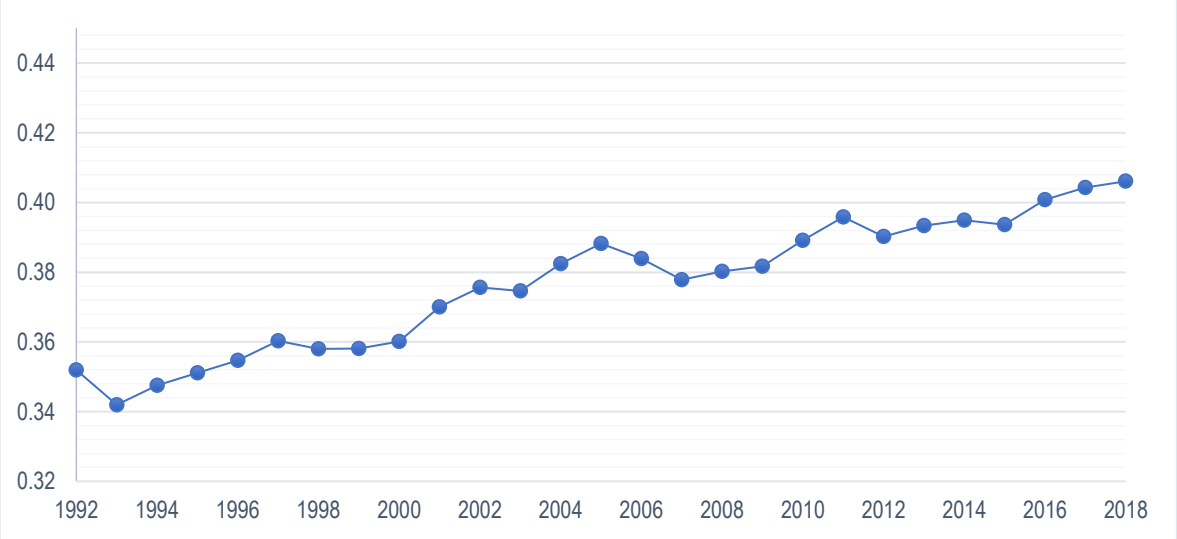


**Figure 1. 8g**. Average stock incentives
The CEO stock holdings incentives ratio estimated as in Bergstresser and Philippon (2006).

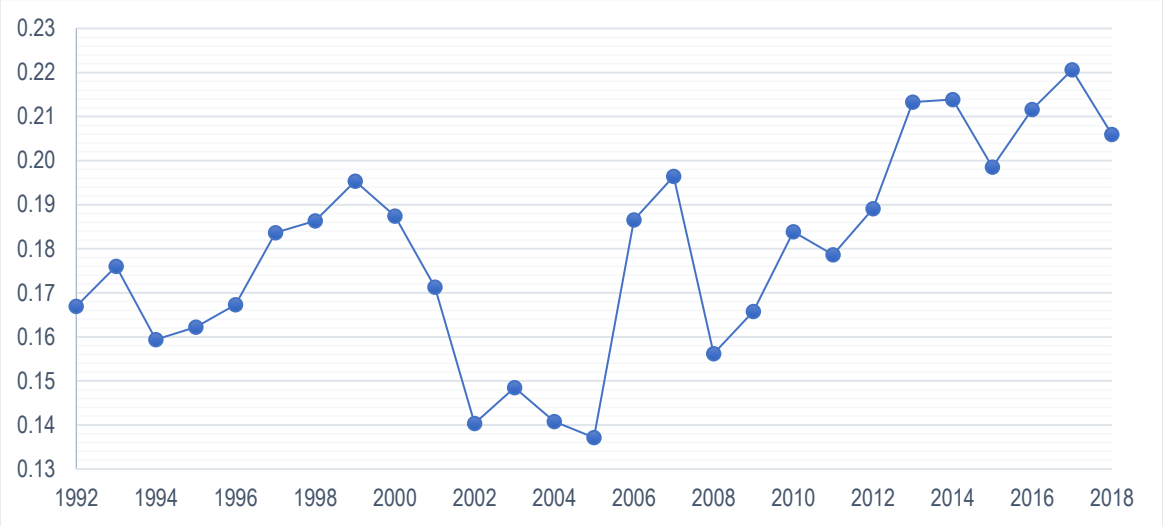



**Figure 1. 8h**. Average option incentives
The CEO option holdings incentives ratio estimated as in Bergstresser and Philippon (2006).

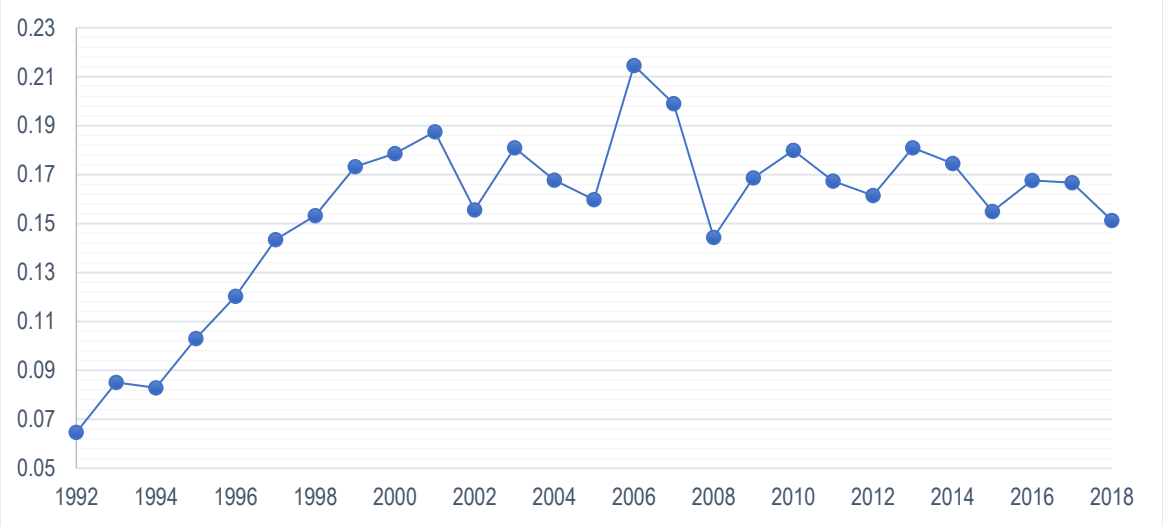


**Figure 1. 9.** Average value of market microstructure characteristics

This figure depicts the average value of market microstructure characteristics (as indicated in each subfigure) for CRSP-Compustat universe, from the earliest year for which sufficient data are available. Detailed definitions of these variables are presented in each subfigure.

**Figure 1. 9a.** Average trading volume
The sum of the trading volume.

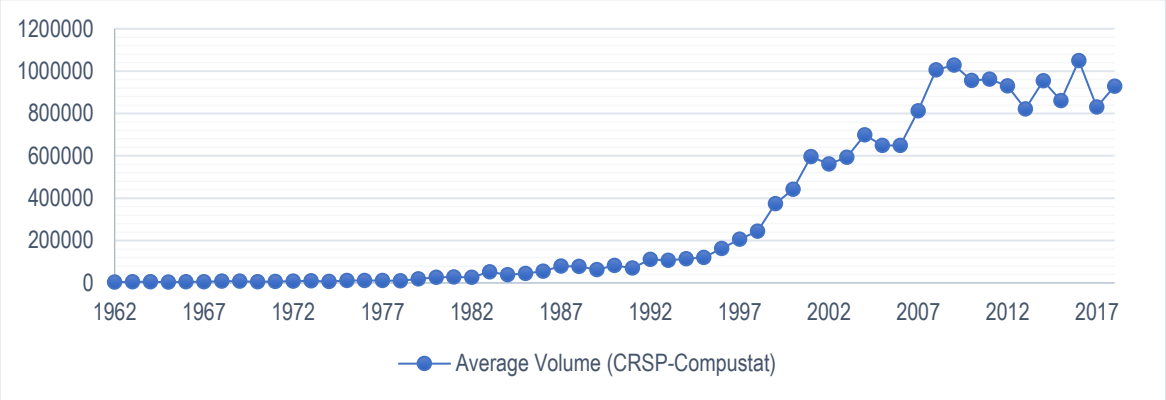



**Figure 1. 9b**. Proportion of firms listed in NYSE-Amex
The proportion of firms listed in NYSE (exchange code 1 as reported by CRSP) and Amex (exchange code 2 as reported by CRSP).

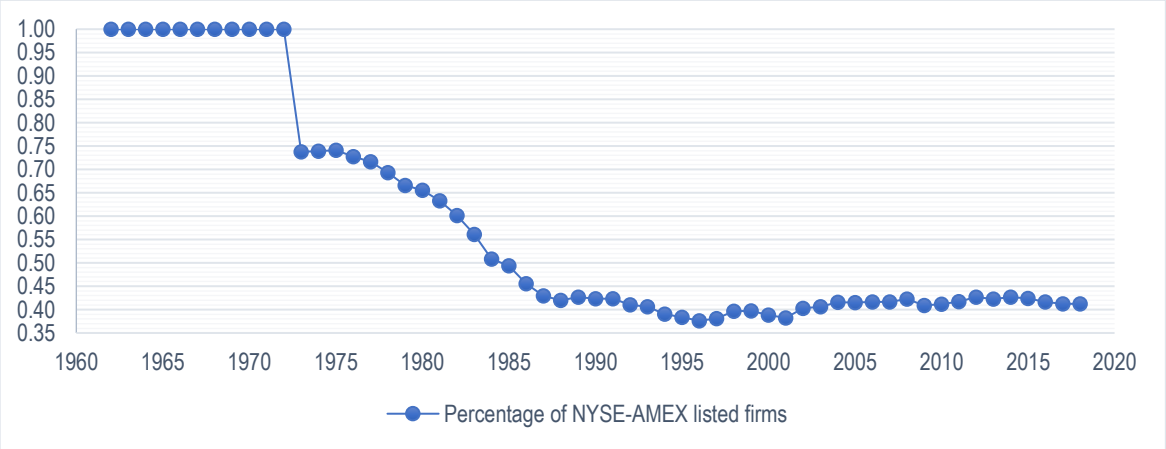



**Figure 1. 9c.** Proportion of market capitalization of firms listed in NYSE-Amex
The proportion of market capitalization of firms listed in NYSE (exchange code 1 as reported by CRSP) and Amex (exchange code 2 as reported by CRSP).

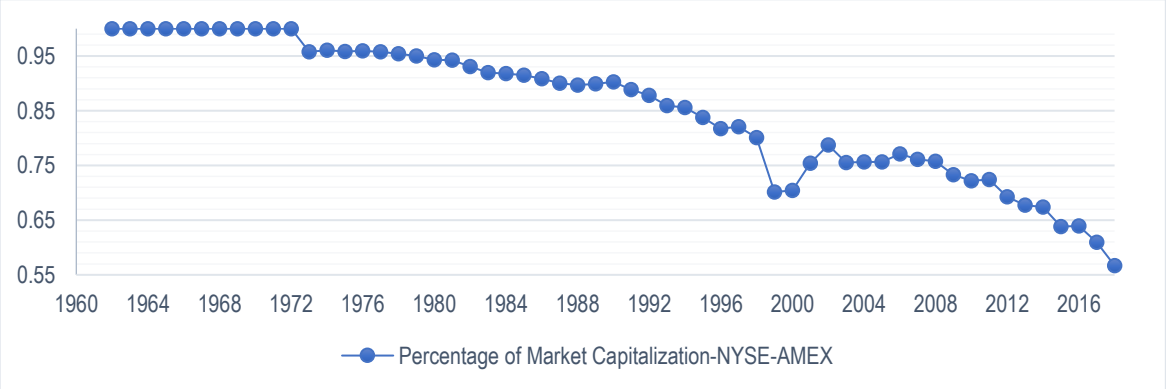


**Figure 1. 9d**. Proportion of firms listed in Nasdaq
The proportion of firms listed in Nasdaq (exchange code 3 as reported by CRSP).

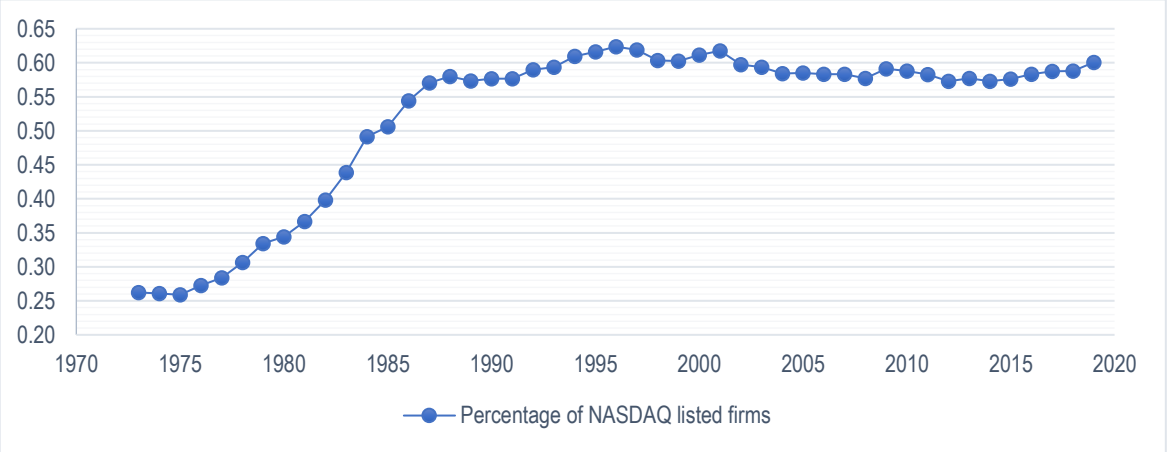
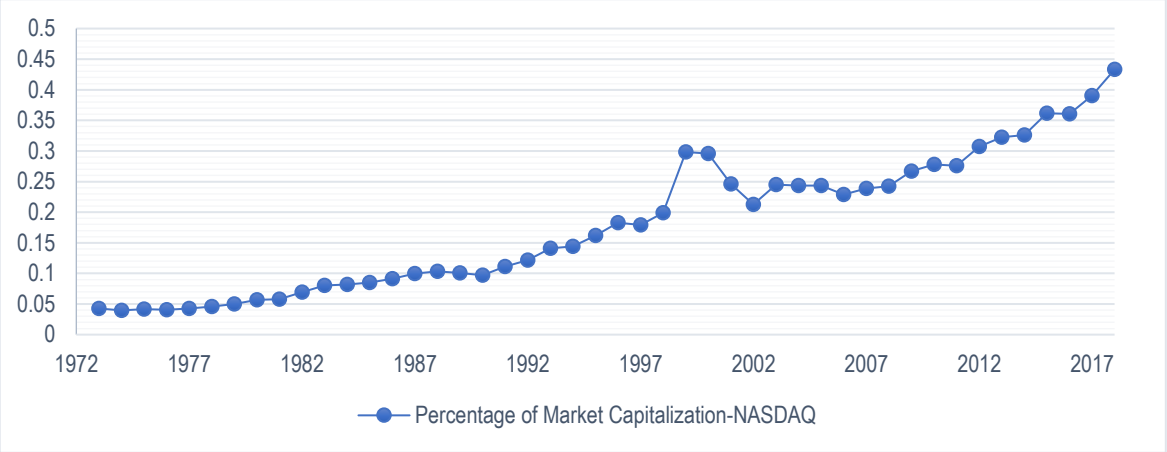



**Figure 1. 9e**. Proportion of market capitalization of firms listed in Nasdaq
The proportion of market capitalization of firms listed in Nasdaq (exchange code 3 as reported by CRSP).



# 9 Tables-Chapter 1

**Table 1. 1. Summary statistics – Pearson Correlation**

This table presents the summary statistics of the stock price crash risk measures, namely CRASH, NCSKEW and DUVOL, Opacity, Overinvestment, and the main control variables. The CRSP-Compustat data set covering the period 1962-2018 is presented in Panel A1 and consists of 106,740 firm-year observations. The CRSP-Compustat-Execucomp data set covering the period 1992-2018 is presented in Panel A2 and consists of 32,203 firm-year observations. The sample comprises of common stocks (*i.e*., share codes 10 and 11) traded in NYSE, Amex or Nasdaq, with stock price greater than 1 USD at the end of fiscal year, and more than 26 weeks of stock returns in a fiscal year. All the differences between Panel A1 and Panel A2 have been tested for the equality and are statistically significant ($p$-values<0.01), with the exception of Leverage and Dturn. Panel B1 and B2 presents the Pearson's correlation coefficients between the stock price crash risk measures. All the coefficients are statistically significant ($p$-values<0.01). All variables are defined in the Appendix.

| Panel A1: Summary Statistics (CRSP-Compustat data set) | | | | | |
|---|---|---|---|---|---|
| **Variable** | **Mean** | **Std Dev** | **Lower Quartile** | **Median** | **Upper Quartile** |
| CRASH | 0.145 | 0.352 | 0 | 0 | 0 |
| NCSKEW | -0.063 | 0.727 | -0.449 | -0.08 | 0.289 |
| DUVOL | -0.083 | 0.343 | -0.307 | -0.093 | 0.128 |
| Opacity | 0.241 | 0.441 | 0.094 | 0.160 | 0.274 |
| Overinvestment | 0.023 | 0.522 | -0.098 | -0.015 | 0.080 |
| Size | 5.622 | 1.997 | 4.142 | 5.468 | 6.989 |
| Sales | 2154.59 | 10878.29 | 62.488 | 237.005 | 1012.6 |
| Market Capitalization | 2023.3 | 6227.82 | 47.625 | 211.395 | 1005.3 |
| Firm Age | 18.751 | 13.69 | 8 | 15 | 26 |
| Market to Book | 2.56 | 3.366 | 1.032 | 1.719 | 2.982 |
| Leverage | 0.497 | 0.222 | 0.335 | 0.501 | 0.64 |
| Return on Equity | 0.034 | 0.406 | 0.023 | 0.104 | 0.162 |
| Return on Assets | 0.014 | 0.153 | 0.008 | 0.044 | 0.079 |
| Dturn | 0.001 | 0.016 | -0.003 | 0 | 0.004 |

| Panel A2: Summary Statistics (CRSP-Compustat-Execucomp data set) | | | | | |
|---|---|---|---|---|---|
| **Variable** | **Mean** | **Std Dev** | **Lower Quartile** | **Median** | **Upper Quartile** |
| CRASH | 0.199 | 0.4 | 0 | 0 | 0 |
| NCSKEW | 0.084 | 0.745 | -0.327 | 0.04 | 0.425 |
| DUVOL | -0.001 | 0.345 | -0.228 | -0.011 | 0.209 |
| Opacity | 0.187 | 0.219 | 0.078 | 0.132 | 0.223 |
| Overinvestment | 0.042 | 0.467 | -0.071 | 0.009 | 0.100 |
| Size | 7.327 | 1.586 | 6.163 | 7.238 | 8.407 |
| Sales | 5634.45 | 18671.68 | 456.327 | 1279.25 | 3917.2 |
| Market Capitalization | 5439.92 | 10006.09 | 553.638 | 1482.98 | 4614.87 |
| Firm Age | 26.446 | 16.992 | 12 | 22 | 41 |
| Market to Book | 3.227 | 3.627 | 1.531 | 2.345 | 3.823 |
| Leverage | 0.521 | 0.221 | 0.365 | 0.528 | 0.665 |
| Return on Equity | 0.085 | 0.359 | 0.048 | 0.115 | 0.182 |
| Return on Assets | 0.042 | 0.106 | 0.02 | 0.051 | 0.088 |
| Dturn | 0.001 | 0.018 | -0.006 | 0 | 0.007 |

**Panel B1: Pearson Correlation (CRSP-Compustat data set)**

| | CRASH | NCSKEW | DUVOL |
|---|---|---|---|
| CRASH | 1 | | |
| NCSKEW | 0.584*** | 1 | |
| DUVOL | 0.531*** | 0.951*** | 1 |

**Panel B2: Pearson Correlation (CRSP-Compustat-Execucomp data set)**

| | CRASH | NCSKEW | DUVOL |
|---|---|---|---|
| CRASH | 1 | | |
| NCSKEW | 0.628*** | 1 | |
| DUVOL | 0.572*** | 0.953*** | 1 |

**Table 1. 2. The impact of the agency-based channels (opacity and overinvestment) on future stock price crashes (CRASH)**

This table presents the marginal effects of logit regression estimates between the one-year-ahead value of CRASH and the agency-based channels of Opacity and Overinvestment measured in year *t*. The estimates presented in Panel A are derived from the CRSP-Compustat data set from 1962 to 2018, while the estimates presented in Panel B are derived from CRSP-Compustat-Execucomp data set from 1992 to 2018. The estimates presented in models (1)-(4) in both Panels include dummy variables to control for time-invariant year and industry-specific fixed effects, while the estimates presented in models (5)-(8) in both Panels include dummy variables to control for time-invariant year and firm-fixed effects. The sample comprises of common stocks (*i.e.*, share codes 10 and 11) traded in NYSE, Amex or Nasdaq, with stock price greater than 1 USD at the end of fiscal year, and more than 26 weeks of stock returns in a fiscal year. All variables are defined in the Appendix. Standard errors are reported in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent, respectively.

**Panel A: CRSP-Compustat data set**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Opacity | | -0.000 | | 0.001 | | -0.000 | | 0.001 |
| | | (0.00) | | (0.00) | | (0.003) | | (0.003) |
| Overinvestment | | 0.006*** | | 0.005*** | | 0.009** | | 0.007** |
| | | (0.00) | | (0.00) | | (0.003) | | (0.003) |
| Stock Return | | | 0.008** | 0.009* | | | 0.021*** | 0.018*** |
| | | | (0.00) | (0.00) | | | (0.004) | (0.005) |
| Dturn | | | 0.009*** | 0.009*** | | | 0.015*** | 0.015*** |
| | | | (0.00) | (0.00) | | | (0.002) | (0.002) |
| NCSKEW | | | 0.005*** | 0.004*** | | | -0.020*** | -0.023*** |
| | | | (0.00) | (0.00) | | | (0.002) | (0.002) |
| NCSKEW (*lag* 1) | | | 0.004*** | 0.004*** | | | -0.018*** | -0.018*** |
| | | | (0.00) | (0.00) | | | (0.002) | (0.002) |
| NCSKEW (*lag* 2) | | | 0.005*** | 0.006*** | | | -0.023*** | -0.021*** |
| | | | (0.00) | (0.00) | | | (0.003) | (0.003) |
| Size | 0.016*** | 0.015*** | 0.013*** | 0.012*** | 0.112*** | 0.116*** | 0.118*** | 0.120*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.007) | (0.009) | (0.007) | (0.009) |
| Firm Age | -0.011*** | -0.010*** | -0.010*** | -0.010*** | 0.044*** | 0.053*** | 0.050*** | 0.057*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.005) | (0.007) | (0.006) | (0.006) |
| Market to Book | 0.005*** | 0.004*** | 0.004*** | 0.003** | 0.021*** | 0.018*** | 0.015*** | 0.013*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.002) | (0.003) | (0.003) | (0.003) |
| Leverage | -0.005*** | -0.005*** | -0.004*** | -0.004** | -0.013*** | -0.013** | -0.011** | -0.012** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.003) | (0.004) | (0.004) | (0.004) |
| Return on Equity | 0.005*** | 0.005*** | 0.005*** | 0.005*** | 0.013*** | 0.012*** | 0.010*** | 0.007* |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.002) | (0.003) | (0.003) | (0.003) |
| Year FE | | | YES | | | | YES | |
| FF12 Industry FE | | | YES | | | | NO | |
| Firm FE | | | NO | | | | YES | |
| Observations | 106740 | 70360 | 92872 | 70311 | 106740 | 70360 | 92872 | 70311 |
| Pseudo Likelihood | -49091.27 | -33914.1 | -42576.98 | -33847.52 | -35801.18 | -24488 | -31102.49 | -24340.57 |
| Pseudo R2 | 0.041 | 0.038 | 0.042 | 0.040 | 0.020 | 0.020 | 0.025 | 0.025 |

| Panel B: CRSP-Compustat-Execucomp data set | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Opacity | | -0.003 | | -0.002 | | -0.007 | | -0.006 |
| | | (0.00) | | (0.00) | | (0.005) | | (0.005) |
| Overinvestment | | 0.006** | | 0.006** | | 0.009* | | 0.008* |
| | | (0.00) | | (0.00) | | (0.004) | | (0.004) |
| Stock Return | | | 0.009** | 0.013** | | | 0.027*** | 0.032*** |
| | | | (0.00) | (0.01) | | | (0.008) | (0.009) |
| Dturn | | | 0.009*** | 0.009*** | | | 0.014*** | 0.014*** |
| | | | (0.00) | (0.00) | | | (0.003) | (0.003) |
| NCSKEW | | | 0.008*** | 0.007*** | | | -0.018*** | -0.018*** |
| | | | (0.00) | (0.00) | | | (0.003) | (0.003) |
| NCSKEW (*lag* 1) | | | 0.004 | 0.003 | | | -0.020*** | -0.020*** |
| | | | (0.00) | (0.00) | | | (0.003) | (0.003) |
| NCSKEW (*lag* 2) | | | 0.010*** | 0.013*** | | | -0.019*** | -0.016*** |
| | | | (0.00) | (0.00) | | | (0.004) | (0.004) |
| Size | -0.009** | -0.009* | -0.010** | -0.011** | 0.126*** | 0.130*** | 0.130*** | 0.131*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.012) | (0.013) | (0.012) | (0.013) |
| Firm Age | -0.006** | -0.009*** | -0.007*** | -0.009*** | 0.036*** | 0.036*** | 0.032** | 0.033** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.010) | (0.011) | (0.010) | (0.011) |
| Market to Book | 0.002 | 0.001 | 0.002 | 0.001 | 0.017*** | 0.018*** | 0.013*** | 0.014*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.004) | (0.004) | (0.004) | (0.004) |
| Leverage | -0.002 | -0.000 | -0.001 | 0.000 | -0.019*** | -0.022*** | -0.018** | -0.019** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.006) | (0.006) | (0.006) | (0.006) |
| Return on Equity | 0.001 | 0.000 | 0.000 | -0.000 | -0.003 | -0.005 | -0.007 | -0.009* |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.004) | (0.004) | (0.004) | (0.004) |
| Year FE | | | YES | | | | YES | |
| FF12 Industry FE | | | YES | | | | NO | |
| Firm FE | | | NO | | | | YES | |
| Observations | 32203 | 28099 | 30844 | 28091 | 32203 | 28099 | 30844 | 28091 |
| Pseudo Likelihood | -17323.7 | -15265 | -16594.4 | -15235.5 | -12763.3 | -11124.2 | -12147.1 | -11055.8 |
| Pseudo R2 | 0.017 | 0.019 | 0.019 | 0.021 | 0.011 | 0.012 | 0.017 | 0.018 |

**Table 1. 3. The impact of the agency-based channels (opacity and overinvestment) on future stock price crashes (NCSKEW)**

This table presents regression estimates between the one-year-ahead of NCSKEW and the agency-based channels of Opacity and Overinvestment measured in year *t*. The estimates presented in Panel A are derived from the CRSP-Compustat data set from 1962 to 2018, while the estimates presented in Panel B are derived from CRSP-Compustat-Execucomp data set from 1992 to 2018. The estimates presented in models (1)-(4) in both Panels include dummy variables to control for time-invariant year and industry-specific fixed effects, while the estimates presented in models (5)-(8) in both Panels include dummy variables to control for time-invariant year and firm-fixed effects. The sample comprises of common stocks (*i.e*., share codes 10 and 11) traded in NYSE, Amex or Nasdaq, with stock price greater than 1 USD at the end of fiscal year, and more than 26 weeks of stock returns in a fiscal year. All variables are defined in the Appendix. Standard errors are reported in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent, respectively.

**Panel A: CRSP-Compustat data set**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Opacity | | 0.009*** | | 0.009*** | | 0.001 | | 0.001 |
| | | (0.00) | | (0.00) | | (0.004) | | (0.004) |
| Overinvestment | | 0.029*** | | 0.028*** | | 0.023*** | | 0.022*** |
| | | (0.00) | | (0.00) | | (0.003) | | (0.003) |
| Stock Return | | | 0.004 | 0.005 | | | 0.004 | 0.000 |
| | | | (0.00) | (0.00) | | | (0.003) | (0.003) |
| Dturn | | | 0.027*** | 0.024*** | | | 0.021*** | 0.020*** |
| | | | (0.00) | (0.00) | | | (0.002) | (0.003) |
| NCSKEW | 0.024*** | 0.018*** | 0.023*** | 0.018*** | -0.036*** | -0.042*** | -0.036*** | -0.043*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.002) | (0.003) | (0.002) | (0.003) |
| NCSKEW (*lag* 1) | 0.016*** | 0.013*** | 0.018*** | 0.015*** | -0.035*** | -0.039*** | -0.034*** | -0.037*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.002) | (0.003) | (0.002) | (0.003) |
| NCSKEW (*lag* 2) | 0.020*** | 0.020*** | 0.020*** | 0.020*** | -0.047*** | -0.048*** | -0.047*** | -0.048*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.003) | (0.004) | (0.003) | (0.004) |
| Size | 0.114*** | 0.105*** | 0.113*** | 0.104*** | 0.211*** | 0.212*** | 0.210*** | 0.212*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.008) | (0.010) | (0.008) | (0.010) |
| Firm Age | -0.036*** | -0.031*** | -0.037*** | -0.031*** | -0.026*** | -0.012 | -0.026*** | -0.012 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.006) | (0.007) | (0.006) | (0.007) |
| Market to Book | 0.043*** | 0.039*** | 0.041*** | 0.037*** | 0.050*** | 0.046*** | 0.048*** | 0.044*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.003) | (0.003) | (0.003) | (0.003) |
| Leverage | -0.037*** | -0.040*** | -0.036*** | -0.039*** | -0.041*** | -0.046*** | -0.040*** | -0.047*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.004) | (0.004) | (0.004) | (0.004) |
| Return on Equity | 0.020*** | 0.019*** | 0.018*** | 0.018*** | 0.023*** | 0.020*** | 0.021*** | 0.019*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.003) | (0.003) | (0.003) | (0.003) |
| Year FE | | YES | | | | YES | | |
| FF12 Industry FE | | YES | | | | NO | | |
| Firm FE | | NO | | | | YES | | |
| Observations | 108572 | 82859 | 108572 | 82859 | 108572 | 82859 | 108572 | 82859 |
| Pseudo Likelihood | -115942 | -90017 | -115874 | -89973 | -110217 | -85455 | -110172 | -85422 |
| R2 | 0.053 | 0.051 | 0.054 | 0.052 | 0.022 | 0.023 | 0.022 | 0.024 |

| Panel B: CRSP-Compustat-Execucomp data set | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Opacity | | 0.001 | | 0.002 | | -0.007 | | -0.006 |
| | | (0.01) | | (0.01) | | (0.007) | | (0.007) |
| Overinvestment | | 0.022*** | | 0.021*** | | 0.015** | | 0.014* |
| | | (0.00) | | (0.00) | | (0.006) | | (0.006) |
| Stock Return | | | 0.008 | 0.011** | | | 0.006 | 0.008 |
| | | | (0.01) | (0.01) | | | (0.007) | (0.007) |
| Dturn | | | 0.019*** | 0.018*** | | | 0.018*** | 0.017*** |
| | | | (0.00) | (0.00) | | | (0.004) | (0.004) |
| NCSKEW | 0.012*** | 0.012*** | 0.011*** | 0.011** | -0.047*** | -0.048*** | -0.048*** | -0.049*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.004) | (0.004) | (0.004) | (0.004) |
| NCSKEW (*lag* 1) | 0.002 | 0.002 | 0.004 | 0.004 | -0.051*** | -0.052*** | -0.049*** | -0.050*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.004) | (0.004) | (0.004) | (0.004) |
| NCSKEW (*lag* 2) | 0.012* | 0.016** | 0.012* | 0.017** | -0.059*** | -0.057*** | -0.059*** | -0.056*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.006) | (0.006) | (0.006) | (0.006) |
| Size | 0.029*** | 0.028*** | 0.028*** | 0.026*** | 0.241*** | 0.247*** | 0.239*** | 0.247*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.018) | (0.020) | (0.018) | (0.020) |
| Firm Age | -0.018*** | -0.017*** | -0.018*** | -0.017*** | 0.114*** | 0.110*** | 0.113*** | 0.110*** |
| | (0.00) | (0.01) | (0.00) | (0.01) | (0.014) | (0.015) | (0.014) | (0.015) |
| Market to Book | 0.025*** | 0.025*** | 0.025*** | 0.025*** | 0.041*** | 0.045*** | 0.040*** | 0.044*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.005) | (0.006) | (0.005) | (0.006) |
| Leverage | -0.029*** | -0.030*** | -0.029*** | -0.030*** | 0.042*** | 0.049*** | 0.042*** | 0.049*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.008) | (0.009) | (0.008) | (0.009) |
| Return on Equity | 0.004 | 0.004 | 0.003 | 0.002 | -0.004 | -0.007 | -0.005 | -0.007 |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.006) | (0.006) | (0.006) | (0.006) |
| Year FE | | YES | | | | YES | | |
| FF12 Industry FE | | YES | | | | NO | | |
| Firm FE | | NO | | | | YES | | |
| Observations | 33575 | 30877 | 33575 | 30877 | 33575 | 30877 | 33575 | 30877 |
| Pseudo Likelihood | -38238 | -35314 | -38225 | -35304 | -36601 | -33721 | -36587 | -33711 |
| R2 | 0.014 | 0.014 | 0.014 | 0.015 | 0.018 | 0.019 | 0.019 | 0.020 |

**Table 1. 4. The impact of the agency-based channels (opacity and overinvestment) on future stock price crashes (CRASH) during the post SOX period**

Panel A of this table presents the marginal effects of logit regression estimates between the one-year-ahead value of CRASH and the agency-based channels of Opacity and Overinvestment measured in year *t*. Panel B of this table presents regression estimates between the one-year-ahead of NCSKEW and the agency-based channels of Opacity and Overinvestment measured in year *t*. Estimates in both panels are derived from the post SOX CRSP-Compustat-Execucomp data set from 2003 to 2018. The estimates presented in models (1)-(4) in both Panels include dummy variables to control for time-invariant year and industry-specific fixed effects, while the estimates presented in models (5)-(8) in both Panels include dummy variables to control for time-invariant year and firm-fixed effects. The sample comprises of common stocks (*i.e*., share codes 10 and 11) traded in NYSE, Amex or Nasdaq, with stock price greater than 1 USD at the end of fiscal year, and more than 26 weeks of stock returns in a fiscal year. All variables are defined in the Appendix. Standard errors are reported in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, **, and * indicate statistical significance at the 1, 5, and 10 percent, respectively.

**Panel A: CRASH**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Opacity | | -0.002 | | -0.000 | | -0.002 | | -0.000 |
| | | (0.00) | | (0.00) | | (0.006) | | (0.006) |
| Overinvestment | | 0.004 | | 0.004 | | 0.001 | | -0.001 |
| | | (0.00) | | (0.00) | | (0.005) | | (0.005) |
| Stock Return | | | 0.013* | 0.017** | | | -0.025*** | -0.026*** |
| | | | (0.01) | (0.01) | | | (0.003) | (0.003) |
| Dturn | | | 0.011*** | 0.011*** | | | -0.015*** | -0.013*** |
| | | | (0.00) | (0.00) | | | (0.003) | (0.003) |
| NCSKEW | | | 0.006** | 0.006** | | | 0.044*** | 0.050*** |
| | | | (0.00) | (0.00) | | | (0.009) | (0.009) |
| NCSKEW (*lag* 1) | | | 0.003 | 0.002 | | | 0.015*** | 0.014*** |
| | | | (0.00) | (0.00) | | | (0.003) | (0.003) |
| NCSKEW (*lag* 2) | | | 0.009*** | 0.011*** | | | -0.023*** | -0.024*** |
| | | | (0.00) | (0.00) | | | (0.003) | (0.003) |
| Size | -0.013** | -0.011** | -0.014*** | -0.015** | 0.137*** | 0.151*** | 0.133*** | 0.142*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.016) | (0.018) | (0.017) | (0.018) |
| Firm Age | -0.006** | -0.010*** | -0.008** | -0.010*** | 0.038* | 0.023 | 0.036* | 0.023 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.015) | (0.016) | (0.015) | (0.016) |
| Market to Book | 0.002 | 0.003 | 0.003 | 0.003 | 0.016*** | 0.018*** | 0.011* | 0.012** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.004) | (0.005) | (0.004) | (0.005) |
| Leverage | -0.003 | -0.000 | -0.000 | 0.001 | -0.023** | -0.022** | -0.016* | -0.014 |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.007) | (0.008) | (0.007) | (0.008) |
| Return on Equity | -0.000 | -0.002 | -0.001 | -0.003 | -0.007 | -0.011* | -0.012** | -0.016*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.005) | (0.005) | (0.005) | (0.005) |
| Year FE | | | YES | | | | YES | |
| FF12 Industry FE | | | YES | | | | NO | |
| Firm FE | | | NO | | | | YES | |
| Observations | 21253 | 19432 | 20661 | 19430 | 21253 | 19432 | 20661 | 19430 |
| Pseudo Likelihood | -11291.95 | -10344.27 | -10950.67 | -10321.25 | -7871.41 | -7147.05 | -7548.46 | -7056.82 |
| Pseudo R2 | 0.012 | 0.013 | 0.014 | 0.015 | 0.008 | 0.008 | 0.020 | 0.020 |

| Panel B: NCSKEW | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Opacity | | 0.006 | | 0.007 | | -0.004 | | -0.001 |
| | | (0.01) | | (0.01) | | (0.010) | | (0.010) |
| Overinvestment | | 0.017** | | 0.016** | | -0.002 | | -0.002 |
| | | (0.01) | | (0.01) | | (0.008) | | (0.008) |
| Stock Return | | | 0.011 | 0.018 | | | 0.041*** | 0.045*** |
| | | | (0.01) | (0.01) | | | (0.012) | (0.013) |
| Dturn | | | 0.016*** | 0.016*** | | | 0.018*** | 0.018*** |
| | | | (0.00) | (0.00) | | | (0.005) | (0.005) |
| NCSKEW | 0.009 | 0.009 | 0.008 | 0.009 | -0.069*** | -0.070*** | -0.069*** | -0.071*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.005) | (0.006) | (0.005) | (0.006) |
| NCSKEW (*lag* 1) | 0.002 | 0.000 | 0.003 | 0.002 | -0.066*** | -0.069*** | -0.063*** | -0.066*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.005) | (0.006) | (0.005) | (0.006) |
| NCSKEW (*lag* 2) | 0.014** | 0.017*** | 0.015** | 0.017*** | -0.046*** | -0.045*** | -0.045*** | -0.044*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.005) | (0.006) | (0.005) | (0.006) |
| Size | 0.017* | 0.019* | 0.015 | 0.015 | 0.397*** | 0.407*** | 0.380*** | 0.391*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.031) | (0.035) | (0.032) | (0.035) |
| Firm Age | -0.010* | -0.011* | -0.010* | -0.011* | -0.097*** | -0.104*** | -0.094*** | -0.102*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.025) | (0.026) | (0.025) | (0.026) |
| Market to Book | 0.019*** | 0.021*** | 0.019*** | 0.020*** | 0.035*** | 0.040*** | 0.033*** | 0.039*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.007) | (0.007) | (0.007) | (0.007) |
| Leverage | -0.029*** | -0.030*** | -0.028*** | -0.029*** | -0.048*** | -0.052*** | -0.043*** | -0.048*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.012) | (0.013) | (0.012) | (0.013) |
| Return on Equity | 0.003 | -0.000 | 0.002 | -0.002 | -0.009 | -0.014 | -0.011 | -0.017* |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.007) | (0.008) | (0.007) | (0.008) |
| Year FE | | | YES | | | | YES | |
| FF12 Industry FE | | | YES | | | | NO | |
| Firm FE | | | NO | | | | YES | |
| Observations | 20855 | 19616 | 20855 | 19616 | 20855 | 19616 | 20855 | 19616 |
| Pseudo Likelihood | -25108.39 | -23708.40 | -25102.92 | -23703.22 | -23707.11 | -22326.98 | -23695.06 | -22315.39 |
| Pseudo R2 | 0.009 | 0.010 | 0.010 | 0.010 | 0.028 | 0.029 | 0.029 | 0.030 |

# Chapter 2

## Revisiting the CEO-crash relationship: Empirical evidence from the managerial rhetoric channel

# 1 Introduction

There is a great volume of studies designating the role of the manager as the key actor in the corporate field. The extensive nature of CEOs' imperative responsibilities support the argument that the manager is either directly or indirectly involved in every vital decision made and this control gives the CEO excessive power to influence the direction of the firm's future and accordingly its outcomes (Finkelstein, Hambrick, and Cannella, 2009). This study not only revisits the crucial role of CEOs and links it with future firm-specific stock price crash risk, but also provides empirical evidence suggesting a channel underpinning this association.

The delegation of authority to managers involves agency risks when managerial interests and incentives are not perfectly compatible with those of shareholders (Jensen and Meckling, 1976). The condition of asymmetric information exacerbates the agency problems and generates the ideal environment for managers to engage in moral hazard behaviors. In the context of firm-specific stock price crashes, the information asymmetry enables managers to withhold negative information from the investors. However, this behavior is impossible to persist for a prolonged time period and when suddenly the cumulative bad news is revealed, stock price crashes are being triggered (Baik, Farber, and Lee, 2011).

The field of firm-specific stock price crashes closely follows the paradigm of agency theory to clarify the manifestation of stock price crashes (e.g. Hutton, Marcus, and Tehranian, 2009; Kim, Li, and Zhang, 2011a; Callen and Fang, 2013, 2015; Kim and Zhang, 2016). The vast majority of the stock price crash studies, which are built on the agency perspective of withholding bad news, accentuate two channels through which stock price crashes may occur; opacity (Hutton, Marcus, and Tehranian, 2009) and overinvestment (Benmelech, Kandel and Veronesi, 2010). Collectively, crash literature suggests that the catalysts for the occurrence of stock price crashes are the agency problems arising from bad news hoarding activities, either because managers systematically engage in earnings management making their firms more opaque, or because they overinvest to pretend that their growth opportunities are still alive.

However, a wave of recent accounting scandals raised serious issues and enforced the responsible authorities to take direct corrective actions and cope with deficiencies in the business environment. A major change with a new regulatory regime has been shaped

with the establishment of Sarbanes-Oxley (SOX) Act of 2002. In the same vein, financial crisis of 2008 can be considered as a milestone which challenged the survival of business entities. SOX and financial crisis serve as natural experimental settings which enable the further investigation of the endurance of stock price crash risk channels. This study investigates the time-varying relationship between the stock price crash risk and the agency-based channels. Specifically, it is observed that the persistence of the channels after the two dominant events that largely affected the corporate world; the Sarbanes-Oxley act of 2002 (e.g. Hutton, Marcus, and Tehranian, 2009; Zhang, 2007; Coates and John, 2007), that reformed intensely the quality and transparency of financial reporting, and the financial crisis (e.g. Kahle and Stulz, 2013; Campello, Graham, and Harvey, 2010; Andreou, Karasamani, Louca, and Ehrlich, 2017), that influenced the corporate decision making by establishing the firm's survival as the priority of managers during the crisis.

It is observed that, while in the past these channels could significantly explain the sharp fall in stock prices, with the passage of time are attenuated. However, casting a critical eye on the firm-specific stock price crash literature, one can observe a puzzle which is manifested through a substantially high percentage of stock price crashes, incapable to represent an extreme event, with an increasing trend as time wears on. Accordingly, while year-by-year the strength and significance of the channels crashes becomes weaker, the incidence of crashes increases dramatically.

In the spirit of the agency theory viewpoint of firm specific stock price crashes, CEOs are incentivized to conceal negative information from investors. In line with the above argument, the role of CEOs is revisited by considering several CEO characteristics and compensation variables, proposed so far by the stock price crash literature.

The findings of the empirical analysis suggest that firms with younger managers are more likely to experience stock price crashes (Andreou, Louca, and Petrou, 2017), while more ably managed firms are less prone to future stock price crashes. Additionally, the results evince that CEOs' incentives to maximize their labour market visibility are associated with higher future crash frequencies (Jia, 2018). Overall, the analysis advocates that CEOs still have a significant impact, which is not abolished by the inclusion of the agency-based channels and endures in the wake of financial crisis.

However, while the role of managers remains of central interest, the channels through which firm-specific stock price crashes are being manifested remain under investigation.

In the context of the intriguing empirical evidence provided, this study continues to penetrate deeper into the investigation of alternative channels through which managers can retain and/or shape investors' expectations.

There is a considerable amount of research investigating the relation between financial reporting quality and stock price crashes. The findings of prior research propose that managers can use more complex reports, both in terms of size and wording, to hide adverse information from the investment community, that results in extreme negative values in the returns' distribution (Ertugrul, Lei, Qiu and Wan, 2017; Kim, Wang and Zhang, 2019). In the same vein, annual reporting is further considered to enhance the understanding regarding the role of textual discussions provided by managers as indicators of company's future performance.

Interestingly, the empirical findings provide evidence suggesting that the positive text features prevailing over the negative and research and development keywords derived from textual analysis from Management's Discussion and Analysis of Financial Condition and Results of Operations (MD&A) are positively associated with one year ahead stock price crash risk. However, the relationship is absent if the full 10K filings are considered or if the focus is on different sections, such as the risk factor section. This finding is consistent with prior research suggesting that the users of financial disclosures, instead of basing their decisions mainly on the audited financial statements, they may rely more on the MD&A (AICPA, 2010; Epstein and Palepu, 1999).

The results are robust to the inclusion of additional textual control variables and controlling for the RD narrative disclosures and the tone within the full 10K filing. Furthermore, the results remain significant during post crisis period, as well. Overall, the empirical findings confirmed the existence of a new channel, the managerial rhetoric channel, through which managers shape investors' expectations.

This study documents several key contributions to the field of firm-specific stock price crashes. Firstly, this chapter examines the empirical relation between opacity and stock price crash over time and provide recent supporting evidence on the statement of Hutton, Marcus and Tehranian (2009) that "in the post SOX years, the relations between discretionary accruals and crash risk essentially disappear". It further investigates the opacity in the post crisis years, as well, and again the analysis demonstrates that the relation becomes weaker as time wears on. This study highlights the fact that although

opacity does not seem to serve any longer as a channel through which crashes occur, a massive portion of the crash studies is built on this assumption. Furthermore, approaching similarly the two channels proposed by the theoretical developments, this study assesses the persistence of overinvestment over time; i.e. in the post SOX and post crisis period. Overall, the results provide evidence suggesting that none of the two agency-based channels still have an impact. Although overinvestment channel has survived over time, it seems that the financial crisis redefined the corporate activities and managed to subjugate the squandering of free cash flows on wasteful investments. Additionally, the CEO-crash relationship is revisited, by taking into account CEO characteristics and incentives proposed by the crash literature as having an explanatory power in explaining the crash occurrences. Firms with younger CEOs and industry tournament incentives appear more vulnerable in experiencing a stock price crash. Contrary, the actions of more-able managers may mitigate the stock price crash risk. Overall, the empirical evidence suggests that CEO-crash relationship is still apparent. Additionally, this study proposes a new channel, the managerial rhetoric channel, which is employed as a vital conduit through which managers convey information to the investment community.

Finally, the empirical analysis conducted distinguishes among the various measures of firm-specific crashes and highlights the differences that exist, both in the estimation process and the reported crash frequency that derives from the measures. In fact, stock price crash literature, utilizes several measures to operationalize the stock price crashes. For instance, the variables may differ regarding their type, meaning that prior literature employs both indicator and continuous variables as a measure of stock price crashes. Furthermore, the type of the variable is not the only aspect that causes crash measures to differ. Specifically, the firm-specific returns are estimated as the residuals from a model that may includes either only the value-weighted market index, or both the value-weighted market index and the value-weighted industry index. Additionally, the model may include either one or two lead and lag terms to allow for non-synchronous trading. Finally, there are also differences in the definition of a week as "crash week". Literature uses two different cut-off points. Specifically, a week is defined as a "crash week", when the firm-specific weekly returns fall at least either 3.09 or 3.2 standard deviation below the mean firm-specific weekly return. Although the abovementioned specifications and benchmarks lead to different estimations of firm-specific stock prices crashes, are used interchangeably by the literature which ignores the sensitivity of the percentages of stock

price crashes to the different approaches of stock price crashes, since recently. This study adds to the crash literature, by examining the alternative measures, cut-off points and model specifications used by stock price crash literature. It shows that although the cut-off point does not affect the frequency of stock price crashes, the model specification appears to have an impact. Not interestingly, a number of the observed stock price crashes can be attributed to their respective industry returns, indicating that the inclusion of the value-weighted industry index in the model is indispensable. Finally, this study proposes an "unalloyed" measure of stock price crash, namely pure crash, that decontaminates from crashes that can be counterbalanced by subsequent or preceding jumps.

The remainder of the study is organized as follows. The next section presents the theoretical and conceptual framework of the study. Section 3 describes the data and the construction of the key variables. Section 4 presents the empirical findings and tests their robustness. Finally, Section 5 concludes.

## 2 Theoretical and conceptual framework

CEO is the highest in the hierarchy of a public firm. Specifically, the CEO is considered as the most powerful leadership figure in a company as it is not only responsible for the performance but also for setting business objectives, designing the organizational structure and controling the distribution of resources to create value (see e.g. Child, 1972; Porter, 1980). It is the CEO who distributes powers and responsibilities, so that resources are coordinated to achieve business goals (Bower, 1972). Furthermore, mangers select the key executives who will occupy the key positions. Their selection constitutes a vital choice since the quality of decision making is a function of the skills of the key executives of the firm (Flynn and Staw, 2004). Therefore, managers consist the driving force behind every pivotal choice in a public company.

The evolution of public corporations both in structure and size, automatically led to the separation of ownership and management and made it necessary to delegate responsibilities and power to specialists and qualified professionals that act as firms' managers. However, the assignment of such vital responsibilities to a third party by the shareholders, involves several potential principal-agent problems that cannot be overlooked. More specifically, managers may not act in the best interests of the shareholders or act partially towards them. This, in the context of the agency theory, can be expressed as abuse of power by managers to pursue financial or other personal pursuits

(Jensen and Meckling, 1976). The condition that enables the manifestation of such behaviors mainly arises from information asymmetry.

The extensive empirical stock price crash risk literature follows the agency theory paradigm of Jin and Myers (2006), in which information asymmetry contributes to hoarding of bad news for a prolonged period. In fact, a great stream of the empirical literature on the determinants of stock price crashes is motivated by the predictions of the theoretical model of Jin and Myers (2006), whereby managers have incentives to hoard bad news, but in some circumstances those incentives collapse, leading to a sudden release of accumulated negative information. When the accumulated unfavorable information comes out at once, stock price crashes typically caused by the arrival of unexpected bad news (Baik, Farber, and Lee, 2011).

## 2.1 Agency-based channels of stock price crashes

The first empirical research on firm-specific stock price crashes is presented by Hutton, Marcus, and Tehranian (2009), who investigate the transparency between financial reporting and stock return distribution. They develop a measure of firm-specific accounting opacity, based on an indicator of earnings management, and show that opaque firms are more susceptible to future stock price crashes. This variable constitutes a keystone in the stock price crash literature since it is inextricably linked with the existence of agency problems and facilitates the bad news hoarding. The majority of the subsequent studies (e.g. Kim, Li, and Zhang, 2011a; Callen and Fang, 2013, 2017; Kim and Zhang, 2016), which are built on the agency perspective of withholding bad news, recognizes opacity as the channel through which other CEO-related variables affect stock price crashes.

Another great stream of the literature, which is built upon the agency perspective, suggests that top executives may invest sub-optimally the available funds into various investment options to serve their personal interests (Bebchuk and Stole, 1993; D'Mello and Miranda, 2010). The top executives' opportunistic behavior can adversely affect investment efficiency. For instance, managerial characteristics such as CEO overconfidence may distort investment decisions (Malmendier and Tate, 2005), influenced by their tendency to overestimate their expected values and underestimate downside risk (Ellina, Mascarenhas, and Theodossiou, 2020). Considering the linkage between agency costs and stock price crashes, CEOs may have incentives that lead them

to select or retain bad investment decisions and withhold bad news to avoid abandoning a sub-optimal investment decision. Therefore, hoarded bad news associated with sub-optimal investments may result to poor performance, which increases accordingly the probability to experience a stock price crash.

The above-mentioned argument has been confirmed by the theoretical development of Benmelech, Kandel, and Veronesi (2010) who suggest that when the growth rate of investment opportunities declines, concerns about managers' personal wealth incentivize them to withhold adverse outcomes from the investors. Furthermore, Habib and Hasan (2017) examined the association among stock price crashes and investment efficiency (both over and under), conditional on managerial ability. The information asymmetry enables top executives to exploit their favorable information for "rent extraction" purposes. Accordingly, investment inefficiency can be considered as another agency-based channel through which CEO-related variables affect the stock price crashes.

Both, opacity and overinvestment enable CEOs to withhold negative information, extract rents and justify their opportunistic behavior, either by concealing bad news through engaging in earnings management or by making overinvestments to pretend that they are still in a growing stage. Both channels underpinning the relationship between the hoarding of bad news practices and stock price crashes, are compatible with the agency perspective of stock price crash risk.

In line with agency problems, once incentives or motivations arise to agents that prevent them to act in the best interest of shareholder, it is challenging to deal with the agency problems in the corporate world. However, in recent years, a number of corporate scandals and corporate collapses have surfaced, although the annual bulletins and financial statements of companies reflect a healthy and profitable depiction (such as Enron, Royal Ahold, Parmalat etc), imposed the authorities to deal with deficiencies in the financial reporting. A major change with a new regulatory regime has been created by the two US senators, Paul Sarbanes and Michael Oxley, with the intention to restore the trust of investment community in US capital markets and establish their protection. Accordingly, SOX of 2002, brought a new era in corporate arena (e.g. Zhang, 2007; Coates and John, 2007). This crucial timing of SOX (2002) is considered as a nodal point that enables the analysis of changes that are applied to the public corporations after the establishment of the new regulatory regime.

In the same vein, financial crisis of 2008 can be considered as a milestone for the business world in general (e.g. Kahle and Stulz, 2013; Campello, Graham, and Harvey, 2010). Similar to Ivashina and Scharfstein (2010), who recognized the peak period of the financial crisis on 2008, the analysis refers to 2008 as the crisis point. The financial crisis serves as a natural experimental setting which enables the investigation of the survival of stock price crash risk channels. It is hypothesized that firms, during crisis periods, appear substantially vulnerable and financial constraints are usually imposed to the majority of them. Accordingly, during an exogenous negative shock, such as the financial crisis, the priority of firm's management is the survival of the company. Therefore, in the presence of a crisis, managers' efforts are devoted to shield the firm and their engagement either in earnings management or sub-optimal investments should be less profound, since these actions will worsen the already distressed condition. Finally, the sudden changes in corporates' environment may cause an exogenous shock on firm's policies.

To sum up, crash literature suggests that the catalysts for the occurrence of stock price crashes are the agency problems that arise from bad news hoarding, either because top managers continuously misstate earnings, or because they invest sub-optimally. Overall, it is hypothesized that firms, after the crucial milestones mentioned, are less likely to be engaged either in earnings management or overinvestment, not only due to new regulation regime that prevent them to do so, but also due to "danger in extinction" during crisis period.

## 2.2 Revisiting the role of CEOs

The literature has extensively examined the important role of top executives in several corporate policies, such as investment, cash policies, accounting practices (Malmendier and Tate, 2005, Florackis and Sainani, 2018; Huang-Meier, Lambertides, and Steeley, 2016; Bergstresser and Philippon, 2006; Florackis and Sainani, 2020). Additionally, a substantial stream of literature on stock price crashes, examines also the relationship between CEO characteristics and stock price crashes (e.g. Callen and Fang, 2015; Andreou, Louca and Petrou, 2017; Habib and Hasan, 2017; Li and Zeng, 2019). For instance, Li and Zeng (2019), in their investigation on the impact of top executive's gender on asset prices, find that female CFOs are negatively associated with stock price crashes. In accordance with their findings, it is expected that any attributes linked with "moral values", or individuals that are considered "by nature as more conservative", will

negatively affect the likelihood of observing a stock price crash. Additionally, Andreou, Louca and Petrou (2017) provide empirical evidence that younger managers have incentives, tied to their personal wealth, to withhold negative news in the early stages of their career and therefore firms with younger CEOs are more likely to experience stock price crashes.

Furthermore, Habib and Hasan (2017) examine the impact of managerial ability on stock price crash risk and document evidence suggesting that more able CEOs make suboptimal investment choices, specifically they over-invest, leading the firm more vulnerable to a stock price crash. In conformity with their conclusions, managers having financial incentives, intend to maximize their personal wealth, by allowing bad news to stockpile, leading to a sudden stock price drop. Moreover, existing literature shows that firms with overconfident managers (Kim, Wang and Zhang, 2016) overestimate their investment choices and therefore deny forgoing negative NPV projects resulting in an accumulation of bad performance and consequently to the occurrence of a stock price crash. Remarkably, this study differs from the above-mentioned work, since it approaches the field by incorporating in the analysis a psychological trait. The overconfidence bias, which leads CEOs to misperceive negative NPV projects as positive, may be also responsible for their unwillingness to reveal any bad news associated with the projects. Therefore, their motives do not lie on exploiting any personal financial incentives, but mainly because indeed, from their standpoint, those projects seem to be profitable.

As far as top executives' compensation is concerned, Kim, Li and Zhang (2011) examined the relationship between top executives' equity incentives and stock price crash risk and documented a weak positive relation between CEOs' incentives and stock price crash risk. In this context, Andreou, Antoniou, Horton, and Louca (2016) show that CEO stock option incentives increase stock price crash risk. Furthermore, acknowledging compensation remuneration as an aligning mechanism between managerial incentives and shareholders' interests, He (2015) showed that CEO inside debt holdings are associated with a reduction in the likelihood of observing firm-specific stock price crashes. Moreover, in the presence of managerial career concerns, there is evidence suggesting that it is challenging to determine the optimal incentive contract (Gibbons and Murphy, 1992). In this vein, He Ren and Taffler (2020) consistent with executives' trading activities for gaining personal benefits, find a positive relation between insider sales and future crash risk.

To sum up, crash literature acknowledges CEO characteristics and incentives as important determinants of stock prices crashes. Considering the large stream of literature which is devoted in investigating the managerial role and their association with stock prices with hypothesized that CEOs still have an impact. However, it is also assumed that their behaviors are not manifested through the two agency-based channels that have been presented above, since the regulatory framework and the strict post crisis financial environment do not permit it. The latter argument directs this study to the investigation of alternative channels.

## 2.3 Alternative channels

Communication in corporate world has long been observed through the lens of narrative and storytelling. Annual reports have been considered as a communication tool that the firm uses to convey messages to its stakeholders (Herremans and Ryans, 1995). There is a considerable amount of research investigating the relation between financial reporting quality and stock price crashes. Specifically, Ertugrul, Lei, Qiu, and Wan (2017) studied the impact of various aspects related to 10K annual reports (i.e. the size and the written tone of the filing) on firm-specific crashes. Their findings suggest that larger 10K's with more words related to the uncertainty and weakness are associated with more stock price crashes. In the same spirit, Kim, Wang and Zhang (2019) reported that less readable 10K's are also associated with more stock price crashes. Taken collectively, managers can use more complex reports, both in terms of size and wording, to hide adverse information from the investment community, that results in extreme negative values in the returns' distribution.

In the same vein, it is argued that text features of 10K annual reports can be further considered to enhance the understanding regarding the role of textual discussions provided by managers as indicators of company's future performance. Given that 10K filings are publicly available, they can be automatically translated as a mean of communication between the firm and the investment community. And in fact, this convenient communication instrumentality is extremely powerful if one considers that the published reports it is the ultimate source of information that anyone would refer to in seeking to collecting data regarding the firm's performance.

Investors, in order to ensure the long-term return on capital employed, scrutinize the company's annual financial statements. The annual reports are supposed to be reliable

and reflect the actual and accurate representation of the firm as they are formed in accordance with generally accepted accounting principles and comply with predetermined criteria. Additionally, the annual reports are subject to independent control by competent, qualified, and independent auditors. The various audit certificates are the seal of the legitimacy of any good management and at the same time compose the safeguard that will prevent or correct mistakes and irregularities. However, the audit is not applied in all sections of annual financial statements. Specifically, while SAS No. 118 (AICPA, 2010) encourages auditors to cautiously search in the MD&A for inconsistencies relatively to the financial statements, the auditing standards do not require MD&A disclosures to be audited.

In the context of financial disclosures, the Securities Act Release No. 6231 (SEC, 1980) obliges the inclusion of Management's Discussion and Analysis of Financial Condition and Results of Operations in 10K filings. The justification of this requirement lies upon the belief that MD&A is an important element that enables managers' responsibility of communicating with stakeholders in a clear and straightforward manner. Specifically, MD&As are presented as "a discussion and analysis of a company's business as seen through the eyes of those who manage that business" (SEC, 1980). Furthermore, existing literature suggests that the narration sections of 10K filings provide information that is as valuable while foreseeing the firm's future prospects (Schipper, 1991).

A great stream of literature emanates from the intuitive recognition of an association between the textual report content and expectations of firm performance. Interestingly, there is also evidence supporting the notion that the users of financial disclosures, instead of basing their decisions mainly on the audited financial statements, they may rely more on the MD&A (AICPA, 2010; Epstein and Palepu, 1999). However, questions have been raised about the safety of prolonged use of the narrative sections of 10K filings, especially when the information is not combined with data extracted from firm's fundamentals. The researchers of the Institute of Chartered Accountants of Scotland provide evidence supporting that managers have a significant influence on the "tone at the top" of firms and this influence has a consequent impact on the quality of financial reporting (Amernic, Craig, and Tourish, 2010). They notably suggest that analysis techniques of CEO letter to shareholders in annual filings can furnish a valuable understanding since they are used by CEOs as a medium to communicate their attitudes and values.

In fact, the nature of management disclosures which largely offer verbal information instead of quantifiable, enables managers to intentionally tailor them to affect public impressions (Neu, Warsame, and Pedwell, 1998). Based on the argument of Merkl-Davies and Brennan (2007) it is hypothesized that the rhetorical devices, and specifically the verbal tone, may be used as a mean to self-servingly bias the narrative.

In the same vein, seeking for supplementary verbal categories that can be utilized as an impression management tool, the attention is turned on research and development keywords. Particularly, the motivation for considering this verbal group of words, arises from the argument that R&D has different significant dimensions linked to information asymmetry that makes it different from the rest capital expenditure (Aboody and Lev, 2000). Accordingly, stakeholders are unable to derive any information regarding the value of firm's R&D and observing their peers cannot facilitate this process since every research endeavor is unparalleled. Additionally, there is empirical evidence suggesting that CEOs include more imprecise R&D disclosures when firm's performance is relatively low, which reflect a fluctuating level of disclosure "fluff", which is found to be associated with forward-looking statements (Merkley, 2014). Furthermore, recent work on this direction provides evidence and stimulating discussions, suggesting that managerial rhetoric in firms that embrace technology and innovation in their 10K filings are attracting short-term horizon investors and are more prone to future stock price crash risk (Andreou, Drivas, Philip, and Wood, 2021). Therefore, it is hypothesized that R&D contributes to information asymmetry and can be furthered considered as a mean to shape investors' expectations.

Overall, the above arguments lead to the hypothesis that insights can be gained by examining the narratological concepts of annual reports and that the materialisation of narrative may evoke expectations among shareholders.

# 3 Research design

This section designates the research This section designates the research design employed in this study. It provides information on how the data were collected and clarifies the concepts used to measure the dependent and explanatory variables.

## 3.1 Sample selection

This study conducts empirical analysis for US-listed firms and covers the period from 1992 to 2018. The sample compromises of data drawn from three databases: Center for Research in Security Prices (CRSP), Execucomp and Compustat. The following selection criteria are then imposed in the spirit of prior studies (Hutton, Marcus, and Tehranian, 2009; Kim, Li, and Zhang, 2011a; Andreou, Louca, and Petrou, 2017): The analysis exclude firm-years with (i) a stock price less than $2.5 at the end of fiscal year, and (ii) fewer than 26 weeks of stock returns in a fiscal year. Additionally, firm-year observations where CEOs are also founders are excluded.[2] The analysis further requires appointed CEOs to remain at their role for at least three years.[3] Firms in the financial services (SIC 6000-6999) and utilities (SIC 4900-4999) are excluded, consistently with prior research. The final sample, with sufficient data to estimate the main control variables, consists of 27,828 firm-year observations, which correspond to 2,443 firms from various industries. The sample used in this study is comparable to those used in prior research relying on data obtained from Execucomp database. Nevertheless, this study embraces a substantial number of observations among the various industries. The industry distributions of the final sample are similar to that in Hutton, Marcus, and Tehranian (2009) study.[4] In the subsequent empirical analyses, the sample varies due to the inclusion of additional variables related to CEO characteristics, CEO compensation and textual analysis, the sample size of which is reported in each analysis respectively.

[2] The firm specific stock price crash risk mainly arises from an agency perspective view of withholding bad news, either by proceeding to suboptimal investment decisions and/or using accounting practices to show an (inaccurately) overstated performance of the firm. Founder CEOs invested their human capital on the business and have no incentives to apply any of the prementioned ways to alter the real image of the business, since they will be the first that will suffer from the consequences of applying such practices.

[3] CEOs with tenure less than two years are excluded to avoid attributing the decisions of the previous CEO to the subsequent. This is in line with the estimation process of opacity and overinvestment measures, which are computed using three-year values to capture the accumulated effect of earnings management and abnormal investment respectively.

## 3.2 Crash risk measures

The definition provided by Jin and Myers (2006), explicates the firm-specific stock price crash risk as an extreme negative value in the distribution of firm-specific stock returns. In line with their definition, the employed stock price crash measure is an indicator variable set equal to one when a firm experiences one or more crash weeks during the fiscal year, and zero otherwise. Following Kim, Wang, and Zhang (2016), the firm-specific weekly returns are estimated as the residuals from the expanded index model presented in *Eq.* (1):

$$r_w = a + b_1 r_{MKT,w-2} + b_2 r_{MKT,w-1} + b_3 r_{MKT,w} + b_4 r_{MKT,w+1} + b_5 r_{MKT,w+2} + b_6 r_{IND,w-2} + b_7 r_{IND,w-1} + b_8 r_{IND,w} + b_9 r_{IND,w+1} + b_{10} r_{IND,w+2} + e_w \quad (1)$$

where $r_w$ is the return on stock in week w, and $r_{IND,w}$ is the Fama and French value-weighted industry index and $r_{MKT,w}$ is the value-weighted market index in that week, as obtained from CRSP database. This expanded model serves the aim of the research investigation to focus only on the component of the returns that cannot be explained either by market or industry returns. The inclusion of industry returns is of an increasing importance, since one industry may be booming or collapsing, without necessarily this happening also to the whole market. Therefore, the inclusion of industry returns better enables the isolation of the idiosyncratic − firm-specific − component of the return and capture the *firm-specific* stock price crash.

Although the empirical literature makes use of this general approach to calculate the firm-specific stock price crashes, the differences in the model estimating firm-specific weekly returns lead to different frequencies of annual stock price crashes. The stock price crash measure, utilized by Hutton, Marcus, and Tehranian (2009), requires the estimation of firm-specific weekly returns as the residuals from the previously presented expanded model. Although, they include *one* lead and lag term of market and industry indexes to allow for non-synchronous trading (Dimson, 1979), their findings would have been qualitatively similar if they have instead included either zero or two leads and lags in the expanded index model, as they mentioned in their study. However, some of the subsequent researches adopted slightly different specifications of model presented in *Eq.* (1). For instance, Kim, Li, and Zhang (2011a) estimate firm-specific weekly returns as the residuals from a model that considers only the market return, including also *two* lead

and lag terms of market index. The expanded model used in the study, is adopted by Kim, Wang, and Zhang (2016). The inclusion of both industry and market indexes, with *two* lead and lag terms, can be considered as a more rigorous approach, which enables researcher(s) to focus on firm-specific factors rather than market or industry ones. Overall, the extant stock crash risk literature appears to employ various nested models to compute firm-specific weekly returns. This triggers the interest to investigate the results of the analyses using different stock price crash risk measures.

The next stage of the estimation process, requires the calculations of firm-specific weekly returns for firm in week t $(W_w)$ which are measured as follows:

$$W_w = \ln(1 + e_w) \quad (2)$$

The estimation of the *Eq.* (2) requires having at least 26 weekly observations. Accordingly, the sample should be restricted into those fiscal years. The choice of the 26 weeks horizon is admittedly somewhat arbitrary. However, this filtering criterion is consistently applied in crash risk studies, increasing simultaneously the comparability between them.

Then, the likelihood of experiencing a crash is measured by a crash indicator variable set equal to one if a firm experiences one or more crash weeks during the fiscal year *t*, and zero otherwise. Hutton, Marcus, and Tehranian (2009), define a week as a "crash week", when the firm-specific weekly returns fall at least 3.09 standard deviation below the mean firm-specific weekly return value in year *t* and a "jump week", when the firm-specific weekly returns is at least 3.09 standard deviation above the mean firm-specific weekly return value in year *t*. The choice of 3.09 standard deviation below the mean is derived from the 0.1% frequency generated in the standard normal distribution.

Assuming that firm-specific returns are normally distributed, it is expected to observe 0.1% of the sample firms crashing in any week. The probability to experience a stock price crash over the fiscal year would be $1-(1-0.001)^{52}$=0.0507. However, the greater observed crash frequency lead future studies to adopt a more "strict" approach for defining a "crash week". For instance, Kim, Li and Zhang (2011a) define a week as a "crash week", when the firm-specific weekly returns fall at least 3.2 standard deviation below the average firm-specific weekly return value in year *t*. Although the abovementioned specifications and benchmarks lead to different estimations of firm-specific stock prices crashes, they are used interchangeably by the literature of stock price

crashes. This gives the motivation for carrying out the research investigation using different thresholds for defining the "crash/jump week".

The subsequent analysis employs an "unalloyed" measure of stock price crash, namely *pure crash*, that *de*contaminates the measure from idiosyncratic returns representing positive jumps. Accordingly, the pure crash indicator variable set equal to one only if the firm experiences at least one "crash week" and not a "jump week" within the fiscal year. The idea of proposing this novel component mainly arises from the fact that some crashes can be counterbalanced by respective jumps, or *vice versa*. In such instances, one could presume that the market "reverses" its reaction and "corrects" any mistaken responses. Consequently, the elimination of the crashes which can be offset by jumps may enhance the ability of this measure in capturing the actual firm-specific stock price crashes. Therefore, this adjustment, contributes in getting the "undiluted" information that it is expected to be retrieved from an unswerving crash measure.

Apart from the crash risk indicator variables, crash studies employ also, as primary crash risk measures, the negative coefficient of skewness (NCSKEW) and down-to-up volatility (DUVOL). Albeit the estimation of these measures is also based on the firm-specific weekly returns, the fact that they take continuous values make them relatively different compared to the crash indicator variables. There is evidence suggesting that the continuous measures may capture even smaller or medium-sized crashes which are mainly caused by the asymmetry on the distribution of returns (Andreou, Andreou, and Lambertides, 2021; Andreou, Cooper, Louca, and Philip, 2017). As a result, positive jumps will confound the estimates of firm-specific crashes. In contrast, when measuring firm-specific crashes the aim is to focus on negative extreme values, not only returns that are negatively skewed. Therefore, the empirical analysis is conducted utilizing the crash risk indicator variable, which serves the purpose of the analysis, i.e. to capture the firm-specific crashes as defined by Jin and Myers (2006). Finally, the sensitivity of the crash indicator variable to large share price falls elucidates the natural preference for employing this measure.

## 3.3 Main explanatory variables

In the spirit of the agency theory viewpoint of firm specific stock price crashes managers are incentivized to withhold negative information from investors. In line with the above

argument, this study considers several CEO characteristics and compensation variables, proposed so far by the stock price crash literature.

### 3.3.1 CEO characteristics and incentives

Kim, Wang, and Zhang (2016) investigate the relationship between overconfident managers and firm specific stock price crashes. Their empirical findings propose that firms with overconfident managers overestimate their investment choices and therefore deny forgoing negative NPV projects resulting in an accumulation of bad performance which consequently causes the occurrence of a stock price crash. Following Campbell, Gallmeyer, Johnson, Rutherford and Stanley (2011) a manager is classified as overconfident if it exhibits a highly optimistic option-holding behavior. Specifically, the classification as an overconfident manager, requires the fulfilment of the condition of holding stock options that are more than 100% in the money. CEO Overconfidence is measured by an indicator variable set equal to one if the CEO is classified as overconfident, and zero otherwise.

Andreou, Louca, and Petrou (2017) provide empirical evidence suggesting that younger managers have incentives to withhold negative news in the early stages of their career. This behavior is associated with irreversible increases in CEO compensation and makes firms with younger managers are prone to future stock price crash risk. The CEO Age is measured as the natural logarithm of CEO age variable, as reported in Execucomp database.

A recent study conducted by Li and Zeng (2019) suggested the impact of female executives on stock price crashes. Specifically, behavioral characteristics interrelated with risk preferences and tendency for compliance, suggest executive gender as a behavioral explanatory variable for the occurrence of stock price crashes. In this context, the analysis includes the Female CEO variable, measured by an indicator variable set equal to one if the CEO is female, and zero otherwise.

A large number of existing studies in the broader literature have examined the role of managerial ability in various perspectives. Habib and Hasan (2017) investigate the impact of managerial ability on the occurrence of stock price crashes and provide evidence suggesting that more able CEOs make suboptimal investment choices, specifically they over-invest, leading the firm more vulnerable to a stock price crash. However, prior research has also illuminated the “positive” side of more able managers.

For instance, Demerjian, Lev, Lewis, and McVay (2013) examine the relationship between earnings quality and managerial ability and established a positive impact of more able managers on earnings quality, in terms of more accurate estimates and judgements. Additionally, Andreou, Karasamani, Louca, and Ehrlich (2017) have emphasized on the mitigating role of more able managers in overcoming underinvestment problems during crisis period. Subsequently, the higher ability of managers to reserve/obtain financing is translated to an increased firm value for more ably managed firms. Along this line, the analysis includes Managerial Ability variable to capture managers' efficiency in generating revenues and perform better than their competitors. Folowing Demerjian, Lev, and McVay (2012) Managerial Ability is measured as the residuals from the following equation:

$$\text{Firm Efficiency}_t = a_o + b_1 \text{Ln}(\text{Assets}_t) + b_2 \text{Market Share}_t + b_3 \text{ Free Cash Flow Indicator}_t + b_4 \text{Business Concentration}_t + b_5 \text{ Foreign Currency Indicator}_t + residuals_t \quad (3)$$

where Firm Efficiency is the firm's return on assets minus the industry's median return on assets, Market share refers to the sales of the firm over the total sales of all firms in each industry, Free Cash Flow Indicator is set equal to 1 when a firm has nonnegative free cash flow (defined as earnings before depreciation and amortization (OIBDP) less the change in working capital (RECT+INVT+ACO−LCO−AP) less capital expenditures (CAPX), Business Concentration is the sum of the square market share of all the firms in an industry and Foreign Currency Indicator is set equal to one when a firm reports a nonzero value for foreign currency adjustment (FCA).

In the same vein, Al Mamun, Balachandran, and Duong (2020) argue that the ability of managers to camouflage negative news is highly associated with their power to exert pressure and determine decisions. Their findings suggest a positive relationship between CEO power and stock price crash risk which is mainly driven by personal incentives. Accordingly, the ability of managers to overstate performance is captured by including CEO POWER which is measured by an indicator variable set equal to one if the CEO is also the chairman of the firm, and zero otherwise.

The equity incentives have been discussed by a great number of authors in literature, sometimes as a mean in aligning the interests of managers and shareholders, and at other times as the "guilty party" associated with financial scandals. In the light of reported Kim, Li, and Zhang (2011a) investigated the relationship between the crashes and top executives' equity incentives and find a weak positive relation between CEOs' incentives and stock price crash risk. There is also evidence suggesting that CEO stock option

incentives increase stock price crash risk (Andreou, Antoniou, Horton, and Louca, 2016). Accordingly, the analysis incorporates Stock Incentives and Option Incentives which are measured using the CEO stock, and option respectively, holdings incentives ratio estimated as in Bergstresser and Philippon (2006).

Seminal contributions have also been made in crash literature, with regard to the impact of the external labour market on managerial decision making. Specifically, Chowdhury, Hodgson and Pathan (2020) find that CEO's industry tournament incentives, which capture CEOs' incentives to maximize their labour market visibility, are effective in mitigating the firm's propensity to experience a stock price crash. However, the literature cannot be considered as conclusive since Jia (2018) provide evidence indicating that tournament incentives induce managers' adverse decisions which, as a result, make their firms more prone to crash risk. Consistent with this finding, Kubick and Lockhart (2020) show that managers with high industry tournament incentives are characterized by a greater propensity to hoard bad news, which in turn results in greater stock price crash risk. To take account of these unequal outcomes, CEO's industry tournament incentives (CITI) are included in the empirical analysis. Following Coles, Li, and Wang (2018), CITI is defined as the natural logarithm of the difference between the total compensation (TDC1) of the second highest paid CEO in the same size (proxied by sales) adjusted Fama-French 48 industry group and the total compensation (TDC1) of the firm's CEO.

### 3.3.2 Channels of Stock Price Crash Risk

The vast majority of the stock price crash studies, which are built on the agency perspective of hoarding bad news, accentuate two channels through which stock price crashes may occur; financial reporting opacity (Hutton, Marcus, and Tehranian, 2009) and overinvestment (Benmelech, Kandel and Veronesi, 2010).

The seminal paper of Hutton, Marcus, and Tehranian (2009) investigates the relation between the transparency of financial statements and the occurrence of a stock price crash. Their findings suggest that accounting opacity, proxied by earnings management, is an important factor driving firm-specific stock price crashes. A voluminous number of the subsequent studies, which are built on the agency perspective of withholding bad news, not only consider it as firm-specific stock price crash determinant factor, but also, they have admitted that earnings management is the primary channel that drives crashes. Accordingly, the assorting measure of opacity is employed, which serves the purpose of

this study to investigate the channels through which stock price crashes occur. Specifically, following Hutton, Marcus, and Tehranian (2009), accounting opacity of an individual firm is measured as the prior three years' moving sum of the absolute value of discretionary accruals (DACC):

$$Opacity_t = Absolute\_Value(DACC_t) + Absolute\_Value(DACC_{t-1}) + Absolute\_Value(DACC_{t-2}) \quad (3)$$

where discretionary accruals (DACC) are estimated by employing the modified Jones model (Dechow, Sloan, and Sweeney, 1995).

Another stream of literature, approaching stock price crashes from an agency perspective, suggests that when firms are experiencing declining growth opportunities, managers overinvest to pretend that they are still at a development and accordingly serve their personal interests. Additionally, crash literature theoretically acknowledged investment inefficiency as a channel through which other CEO-related variables can affect the occurrence of a stock price crash (Kim, Wang, and Zhang, 2016). Hence, the assorting measure of overinvestment is employed, which serves the purpose of this study to investigate the channels through which stock price crashes occur. Following Richardson (2006), overinvestment (Overinvestment) is measured as the three-year abnormal/unexpected investment, over and above the investment expenditure necessary to maintain assets in place.

### 3.3.3 Textual Variables

Research investigators have examined the relation between financial reporting quality and stock price crashes. For instance, Ertugrul, Lei, Qiu and Wan (2017) investigate the impact of various characteristics related to 10K annual reports (i.e. the size and the written tone of the filing) on firm-specific crashes. Their empirical results suggest that larger 10K filings, which include more words related to the uncertainty and weakness are positively related to future stock price crashes. Accordingly, the analysis incorporates several textual variables as defined by Loughran and McDonald's dictionary (2011): Tone is measured as the percentage of positive words minus the percentage of negative words; Uncertainty is measured as the percentage of words conveying uncertainty; Modal Weak is measured as the percentage of modal weak words; Litigious is measured as the percentage of words related to litigation; Size 10K is measured as the natural logarithm of the file size in megabytes of the SEC EDGAR "complete submission text file" for the 10K filing. The Tone is measured from textual analysis derived from the full 10K filing, the Item 1A and the Item 7, denoted as Tone 10K, Tone Item1A and Tone Item7, respectively.

Furthermore, existing empirical findings suggest that CEOs adjust RD disclosures based on earnings performance to convey information to the investors (Merkley, 2014). Therefore, this study considers RD narrative disclosures which are operationalized by three different proxies based on Merkley's (2014) dictionary, denoted with the following abbreviations: (i) RD is used for Merkley's dictionary, (ii) RD-FW is used for the combination of Merkley's dictionary with forward looking words and (iii) RD-REDUCED is used for the reduced form of Merkley's dictionary. All three alternatives are applied to the full 10K filing, the Item 1A and the Item 7 and measure the percentage of sentences in firms' 10K filings with RD related keywords as described above. The "10K", "Item1A" and "Item7" next to the variable name, determines the source of the textual analysis.

### 3.3.4 Control Variables

Research on stock price crash risk suggests a large array of control variables that are potentially associated with the crash occurrences. For instance, there is a higher stock price crash propensity for less profitable firms, highly levered firms, firms with smaller age and size and firms with higher growth. Thus, following prior crash studies, within the context of the investigation, the analysis accounts for Leverage, estimated as the ratio of total liabilities to total assets; Market To Book, the ratio of market value to book value of equity; Roe, estimated as the ratio of income before extraordinary items to equity; Size, estimated as the natural logarithm of total assets at fiscal year-end; and Firm Age, estimated as the number of years that the firm is covered in the Compustat universe. Furthermore, prior literature suggests that firms with higher past returns are more likely to have a more negative skewness (Harvey and Siddique, 2000). To take this into account, past returns (Return) are estimated as the average firm-specific weekly returns during the fiscal year (Chen, Hong, and Stein, 2001). The inclusion of detrended turnover (Dturn), estimated as the detrended average weekly stock trading volume during the fiscal year, controls for time-varying impacts on skewness. The endogeneity concerns are circumvented by the inclusion of lag values of the negative coefficient of skewness (NCSKEW). Additionally, the analysis controls for departing CEOs (CEO Departure). Specifically, CEO Departure is proxied by an indicator variable set equal to one if there is a departure in firm's CEO, during the fiscal year *t*, and zero otherwise. An indicator variable is set equal to one if we are one, two or three fiscal years before the year of the

CEO departure, (denoted as 1Y Before, 2Y Before and 3Y Before, respectively), to capture the opportunistic behavior which could be more severe during this timing (Andreou, Louca and Petrou, 2017). Specifically, CEOs are appeared to act opportunistically in the years prior to their departures, by overly hiding negative news from investors, to increase their personal wealth.

The empirical specifications include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All explanatory and control variables are described in the Appendix.

# 4 Empirical results

This section presents the study's results in six sub-sections. The first sub-section provides the annual statistics for the stock price crash and pure stock price crash measures while the second sub-section presents their Pearson correlation coefficients. The third sub-section presents summary statistics for the variables employed in the empirical analysis. The fourth sub-section deals with the agency-based channels of stock price crashes. The fifth sub-section Revisits the role of CEO characteristics and incentives. The sixth sub-section proposes the managerial rhetoric channel of stock price crash risk.

## 4.1 Annual stock price crash statistics

Table 2.1 reports annual statistics for the stock price crash and pure stock price crash measures. Specifically, the table lists the percentages of annual stock prices crashes derived from estimated firm-specific weekly returns by using different model specifications and thresholds. Both Panels A and B demonstrate the percentages derived from employing the market model specification, and the market-industry model specification. The threshold for the estimations in Panel A is 3.09 standard deviations, while the threshold in Panel B is 3.2 standard deviations. Overall, the trend of stock price crash occurrences remains unaffected indicating that more recent years are more prone to stock price crashes, using either different model specifications or thresholds. However, the percentages differ due to the differences in the model used to estimate firm-specific weekly returns. For instance, when the estimation of firm-specific weekly returns is performed using the model that includes only the market index (denoted as M) the percentages of stock price crashes and pure stock price crashes are higher in comparison

with the percentages derived from the model that includes both the market and the industry index (denoted as MI). Furthermore, different thresholds used for the definition of the crash week result in different frequencies. As it is observed in Panel A, where a "crash week" is considered when the firm-specific weekly returns fall at least 3.09 standard deviation below the mean firm-specific weekly return value in year t, the percentages of stock price crashes and pure stock price crashes are higher than if the 3.2 standard deviations is used as a threshold. The results are consistent with prior literature. For instance, the 23.97% average percentage of stock price crashes derived from the model with the market index and a threshold of 3.09 standard deviations, is in line with the mean value of 25.4% reported in Li and Zeng (2019), who employ a more recent, albeit smaller, sample period (2007-2016). However, even with a higher threshold (3.2), the average frequency of stock price crashes is still higher in more recent years (20.81%). Overall, this table demonstrates that: (i) the incidence of stock price crashes escalates as time passes, (ii) some of the observed firm-specific stock price crashes can be explained by their respective industry returns and (iii) some of the observed firm-specific stock price crashes can be revoked by preceding or subsequent jumps.

**[Insert Table 2.1, here]**

## 4.2 Correlations

Table 2.2-Panel A presents the Pearson correlation coefficient between the various stock price crash and pure stock price crash measures, using different model specifications and thresholds. All correlation coefficients in Panel A are statistically significant (p-value<0.01). As it was expected, the crash and pure crash measures are highly correlated, since pure crash measures differ only in the recognition of stock prices crashes which are not being offset by corresponding jumps during the fiscal year. The same applies with the measures employing different thresholds to define a "crash week". The measures utilizing a 3.2 standard deviations' threshold are expected to be highly correlated with the measures utilizing a 3.09 standard deviations' threshold, since it is just a more "strict" approach for defining a crash week. Interestingly, what was not expected, is the relatively low correlation (less than 70%) between the measures estimated by market model (M) and the measures estimated by both market and industry model (MI). This is a clear indication that the choice of the model specification is of an increasing importance and that the various crash measures can not be used interchangeably.

Table 2.2-Panel B presents the Pearson correlation coefficient between the various stock price crash and pure stock price crash measures with the agency-based channels, opacity and overinvestment. A relatively low positive correlation coefficient is observed between the two channels with all eight crash and pure crash measures, indicating that other variables may need to be investigated. Additionally, the correlation among overinvestment and opacity is low, positive and also statistically significant (p-value<0.01).

**[Insert Table 2.2, here]**

## 4.3 Summary statistics

Table 2.3 presents summary statistics for the variables employed in the empirical analysis. The 0.201 (0.400) average mean value (standard deviations) of the eight different crash and pure crash measures suggests that approximately 20% of firm-years demonstrate one or more crash events. The means and standard deviations of the crash risk measures are comparable to those reported in prior studies (see, e.g., Kim, Li and Zhang, 2011a; Andreou, Antoniou, Horton and Louca, 2016). With respect to the agency-based channels, the mean value (standard deviation) of Opacity is 0.187 (0.220) and Overinvestment is 0.044 (0.210). The stock and option incentives for an average CEO in the sample is 0.172 and 0.162, respectively. In terms of CEO's industry tournament incentives, the mean (standard deviation) is 8.390 (2.878). With regards to variables related to CEO characteristics mean values (standard deviations) are 0.422 (0.494) for CEO Overconfidence, 55.904 (7.435) for CEO Age, 0.728 (0.445) for CEO power, -3.539 (9.706) for Managerial Ability and 0.023 (0.150) for Female CEO. With respect to the variables related to 10K filings, and specifically to the entire document, mean values (standard deviations) are -0.829 (0.458) for Tone 10K indicating that the average negative tone prevails the positive, 0.918 (1.404) for RD 10K, 0.539 (0.912) for RD-FW 10K and 0.704 (1.010) for RD-REDUCED 10K. The respective mean values (standard deviations) regarding the textual variables of the Risk factor section (Item1A) are -0.002 (0.002) for Tone Item1A, 2.063 (3.73) for RD Item1A, 1.267 (2.593) for RD-FW Item1A, 1.449 (3.28) for RD-REDUCED Item1A. Regarding the MD&A section (Item 7) the Tone Item7, RD Item7, RD-FW Item7 and RD-REDUCED Item1A have mean values (standard deviations) of -0.001 (0.002), 1.156 (2.687), 0.660 (1.942) and 0.970 (2.309),

respectively. The values of RD-FW and RD-REDUCED are lower relatively to the RD since they constitute a subsection of the latter.

The distribution characteristics of control variables are largely consistent with those reported in prior studies. For instance, the average firm in the sample has a size of 7.3 (1.581), natural logarithm of firm age of 2.760 (0.547), market to book ratio of 3.193 (3.633) and leverage of 0.509 (0.213). The sample firms have a mean (standard deviation) return on equity of 0.100 (0.295) and an average firm-specific weekly return of -0.127 (0.136). The detrended average weekly stock trading volume is 0.001 (0.018) and the mean (standard deviation) negative coefficient of skewness of 0.094 (0.784). The mean (standard deviations) percentage of words conveying uncertainty, weakness and litigation are 1.194 (0.338), 0.486 (0.18) and 1.649 (0.863), respectively. The average 10K filing has a natural logarithm of Size of 14.546 megabytes and a standard deviation of 1.708. The average firm spends the 0.032 portion of its total assets for research and development with a standard deviation of 0.053.

**[Insert Table 2.3, here]**

## 4.4 Agency-based channels of stock price crashes

The following empirical analysis draws motivation from the findings of the first chapter and seeks to elucidate the relationship between stock price crash risk and the agency-based channels. To dig deeper into prior findings, following Hutton, Marcus and Tehranian (2009), a logit regression analysis is conducted by employing the model presented in Eq. (4):

$$CRASH_{j,t+1}=a_j+ b_1\ Overinvestment_j+b_2\ Opacity_j+b_3\ Opacity^2_j+Baseline\ Controls+Industry\ FE+ Year\ FE+e_{j,t} \quad (4)$$

Table 2.4 reports logit regression estimates for the relationship between overinvestment and opacity, with one-year ahead stock price crashes. The results reported in Models (1) to (3) derived from logit regressions with CRASH - Market measure as a dependent variable, while the dependent variable in Models (4) to (6) is PURE CRASH - Market measure. The 3.09 threshold is deemed suitable for the estimations as it enables comparisons with the seminal study of Hutton, Marcus and Tehranian (2009). All models include a constant and the standard errors (provided in parentheses) are clustered at the firm level. All continuous variables are standardized to have a mean value of zero and

variance of one to avoid potential influences attributed to scaling differences. It is observed that the overinvestment channel appears positive and strongly significant (p-value<0.01) in all model specifications, indicating that the odds to experience a stock price crash is heightened by 5.65% (Table 2.4, Model (1)). The overinvestment is still significant and positive in an aggregate model that includes also the opacity and opacity square (Table 2.4, Model (3)). Additionally, the impact and significance of overinvestment remains unchanged using the PURE CRASH – Market measure (Table 2.4, Models (4) & (6)). However, even the results of Hutton, Marcus, and Tehranian (2009) are replicated for their sample period, in study's more recent and restricted sample by the inclusion of data obtained from Execucomp database, there is no evidence suggesting that opacity affects positively the stock price crash occurrence. This is consistent with their finding that earnings management decreases as time wears on, indicating that firms are confronted with a harder situation to conceal information through fraudulent financial reporting (Hutton, Marcus, and Tehranian, 2009).

**[Insert Table 2.4, here]**

Table 2.5 reports logit regression estimates for the relationship between overinvestment and opacity, with one-year ahead stock price crashes. The results reported in Models (1) to (3) derived from logit regressions with CRASH - Market-Industry measure as a dependent variable, while the dependent variable in Models (4) to (6) is PURE CRASH - Market-Industry measure. The threshold utilized for the estimations is 3.09 standard deviations. The results are qualitatively similar with the analysis conducted with the two alternative measures of stock price crash presented in Table 2.4. Specifically, the coefficient of opacity is statistically insignificant. overinvestment appears to have a slightly lower significance, while it is still heightening the probability to experience a stock price crash by approximately 3%.

**[Insert Table 2.5, here]**

Tables 2.4 and 2.5, take into account the control variables proposed by prior literature on stock price crashes. Control variables generally have the expected sign. For instance, younger firms and firms with less profits are more prone to experience a stock price crash. There is also a positive and statistically significant relationship between average firm-specific weekly returns, detrended turnover and negative coefficient of skewness with the

occurrence of a stock price crash. Finally, the probability to experience a stock price crash is greater one (1Y Before) and two years (2Y Before) prior to the CEO departure.

The following empirical analysis investigates the time-varying relationship between the stock price crash risk and the agency-based channels. Specifically, two important events are taken into consideration: the Sarbanes-Oxley Act of 2002 and the financial crisis. These events are acknowledged as a "station point" for the corporate world, since Sarbanes-Oxley Act was intended to reduce earnings management and financial crisis challenged the survival of most firms. This further analysis enables enhancing the understanding in terms of the following aspects: (i) if the impact of the agency-based channels have been softening over time, (ii) if any of the considered events alter their influence and (iii) if any of the agency-based channels still have an impact. Therefore, the model is expanded by including the POST SOX, CRISIS and POST CRISIS variables, along with their interactions with the agency-based channels.

Table 2.6 reports logit regression estimates for the relationship between overinvestment and opacity over time, i.e. before and after the events of SOX and CRISIS, with one-year ahead stock price crashes. Starting from this point on, the empirical analysis continues by employing the pure crash measures. Model (1) reports regression results derived from the Market model, while Model (2) reports regression results derived from the Market-Industry model, along with their marginal effects. Following Hutton, Marcus, and Tehranian (2009), this table reports the marginal impact of each explanatory variable, which illustrates the increase in the probability of a crash associated with a shift from the first (Q1) to the third quarter (Q3) of the distribution of each explanatory variable, while holding all the rest explanatory variables at their mean value. The coefficient of opacity appears consistently statistically insignificant, over time. Using the PURE CRASH (3.09-M) measure, overinvestment remains strongly statistically significant (p-value<0.01), indicating that the odds to experience a stock price crash is heightened by 11.6%. After Sarbanes-Oxley Act, specifically during the 2003 to 2007 period, overinvestment appears to have a lower impact on the probability of experiencing a stock price crash, increasing it by 4.19% (11.6%-7.41%). Its impact is getting even lower during the crisis period (2008-2012), where increases the probability of experiencing a stock price crash by only 1.55% (11.6%-10.05%). By observing the marginal effects, its impact totally evaporates. The overinvestment during 2013 to 2017 time period appears insignificant. However, using the PURE CRASH (3.09-MI) measure, while the overall overinvestment is still

significant (p-value<0.05) with a positive impact of 6.6% on the crash probability, after Sarbanes-Oxley Act and during crisis period appears insignificant. In contrast, it appears significant during the post crisis period (2013-2017), but totally offsets the positive impact, turning the overall impact into negative, i.e. overinvestment during 2013-2017 reduces the probability to experience a stock price crash by 2.74% (6.6%-9.34%). The marginal effects results are also consistent, reporting a greater negative coefficient for the post crisis overinvestment.

Overall, the results provide evidence suggesting that none of the two agency-based channels still have an impact. Although overinvestment channel has survived over time, it seems that the financial crisis redefined the corporate activities and managed to subjugate the squandering of free cash flows on wasteful investments. The findings are in line with the expectations discussed previously–that the crucial milestones of SOX and financial crisis brought a new era in corporate arena.

**[Insert Table 2.6, here]**

## 4.5 Revisiting the role of CEO characteristics and incentives

The empirical analysis provided in this subsection investigates the CEO-crash relationship by using a large array of CEO characteristics and incentives, proposed by prior crash literature as potential firm-specific stock price crash determinants. The logit regressions are conducted by employing the PURE CRASH Market-Industry measure. Table 2.7 reports logistic regression estimates for the relationship between CEO characteristics and incentives, with one-year ahead stock price crashes. Models (1) and (2) include variables related to CEO incentives, while Models (3) to (7) include variables related to CEO characteristics. With regards to CEO incentives, Option incentives (p-value<0.05) and CITI (p-value<0.01) appear to significantly increase the probability of experiencing a stock price crash. As far as CEO characteristics are concerned, the findings suggest that CEO Age (p-value<0.05) and Managerial Ability (p-value<0.01) have a statistically significant negative impact on firm-specific stock price crashes.

The findings regarding option incentives are consistent with Kim, Li and Zhang (2011a) who find a weak positive relation between CEOs' incentives and stock price crash risk and Andreou, Antoniou, Hutton, and Louca (2016) who provide evidence that CEO stock option incentives increase stock price crash risk. Additionally, the positive crash-

tournament incentives relationship, which is in line with Jia's (2018) and Kubick and Lockhart's (2020) findings, highlights the significant implications of corporate compensation policies on for managerial behavior. Furthermore, consistent with Andreou, Louca, and Petrou (2017), it is showed that firms with younger managers are more likely to experience stock price crashes. With respect to more-ably managed firms, the provided evidence supports the mitigating role of more able managers. Specifically, Managerial Ability measure is employed, based on managers' efficiency in generating revenues and perform better than their competitors and report a negative relation between more able managers and future stock price crash risk. The findings are in line with the "positive side" of managerial ability, as demonstrated by Andreou, Karasamani, Louca, and Ehrlich (2017) which argue that more able managers can overcome underinvestment problems during crisis period. Overall, the results may reflect the possibility that managers with a higher ability, have less need to engage in any practices that trigger stock price crashes.

**[Insert Table 2.7, here]**

The bulk of the empirical stock price crash literature considers opacity and overinvestment as the channels through which several variables can affect stock price crashes. The conducted empirical analysis presented in this Table 2.8 examines the robustness of the prior findings regarding the CEO-related determinants, at the inclusion of the agency-based channels. This inclusion enables the investigation of whether the agency-based channels are the channels through which the CEO-related variables affect the crash risk. If this is the case, it is expected that the impact of the CEO-related variables will be reduced or even eliminated. However, if they are still significant, it means that there is an alternative channel through the CEO-related variables exert an effect on crash propensity.

Table 2.8 presents logistic regression estimates for the relationship between CEO characteristics and incentives, with one-year ahead stock price crashes, taking into consideration the agency-based channels. While in Models (2) and (5) and Models (4), (6) and (7), overinvestment appears statistically significant at 10% and 5% levels, respectively, this does not affect CEO-related variables. Models (8), (9) and (10) present aggregate combinations of CEO-related variables. Specifically, Model (8) includes all the CEO-incentives, Model (9) all the CEO-characteristics and Model (10) both CEO-incentives and CEO-characteristics. overinvestment appears statistically insignificant in

all aggregated combinations. With respect to the CEO-related variables the results fully support the prior findings, i.e. the results remain unaffected after controlling for the agency-based channels. The findings support the suggest that any future endeavors to enhance research towards the field of stock price crashes should consider alternative channels through the lenses of the emerging corporate arena.

**[Insert Table 2.8, here]**

The following empirical investigation centers the role of managers in the wake of financial crisis. The particular findings presented in Table 2.6 with regards to the impact of crisis on overinvestment foreshadows the fact that crisis totally transfigured the financial landscape. Following a similar line of reasoning as for the analysis in Table 2.6, this section investigates the relationship between CEO characteristics and incentives, with one-year ahead stock price crashes, by isolating their effect during post crisis period. Intriguingly, the logit regression estimates presented in Model (1) of Table 2.9 show that the impact of option incentives reverses during the post crisis period, demonstrating a statistically significant (p-value<0.01) negative relation with stock price crash risk. This contrary finding most likely connotes one of the hard-earned lessons from the crisis. Specifically, the results may demonstrate the broader efforts taken ex-post to rectify incentives which encourage excessive risk taking behaviors resulting in lethal effect for company's survival.

With regards to the rest CEO-related variables the results are consistent with prior findings presented in Table 2.8. Specifically, Model (2) presents the positive statistically significant (p-value<0.01) impact of CITI on stock price crash risk, while Model (4) presents the negative statistically significant (p-value<0.05) association between CEO Age and crashes. Finally, in terms of Managerial Ability, the findings reported in Model (3) reveal an even stronger negative relation between more able managers and crashes, suggesting that their mitigating role becomes more important in the post crisis era.

**[Insert Table 2.9, here]**

## 4.6 Proposing a new stock price crash risk channel

The analysis continues to penetrate deeper into the investigation of alternative channels. If managers do not conceal information from investors through opaque financial reporting or overinvestment, but still have significant influence over the firm-specific stock price

crash risk, then which practices permit them to do so? The subsequent analysis attempts to gain more insight into how managers retain investors' expectations. This study suggests that text features of Company's annual reports (10K filings), which are publicly available, can be further considered to enhance the understanding regarding the role of textual discussions provided by managers as indicators of company's future performance.

Table 2.10 presents logit regression estimates for the relationship between the tone of 10K filings, with one-year ahead stock price crashes. The Tone variable presented in models (1), (3) and (5) derives from textual analysis of Risk Factors section of 10K filings denoted as Item1A, while the Tone variable presented in models (2), (4) and (6) derives from textual analysis of Management's Discussion and Analysis section of 10K filings denoted as Item7. Findings for Models (2), (4) and (6) evince a positive statistically significant (p-value<0.01) relation between the stock price crash risk and the Item 7 tone, the coefficients of which are 0.0703, 0.073 and 0.075 respectively. However, this relation is absent in Models (1), (3) and (5), where the tone of Item 1A is being investigated. All model specifications control for the Tone in full 10K filings to ensure that the results are not driven by the overall tone. Furthermore, this analysis reports results controlling for the size of the 10K filing, which proxies for the relative readability, and words related to litigation to eliminate the possibility that arisen firms' disputes that may wind up in a lawsuit affect the results. The positive association between Item 7 tone and one-year ahead stock price crash risk persists with the inclusion of other control variables derived from textual analysis. For instance, consistent with Ertugrul, Lei, Qiu and Wan (2017), models (3) and (4) control for modal weak words and models (5) and (6) control for words for conveying uncertainty.

Overall, the results are not driven by text discussions capturing uncertainty, modal weak words or keywords and phrases related to litigation. The overall tone of the full 10K filing or the filing size does not affect the findings. The results in Table 2.10 suggest that when positive text features prevail over the negative, the firm becomes more prone to experience a stock price crash. This finding establishes the managerial rhetoric channel.

**[Insert Table 2.10, here]**

Intrigued by the preceding findings, the importance of narratives is scrutinized by investigating the relationship between Research and Development (RD) narratives, with one-year ahead stock price crashes. The RD narrative disclosures are operationalized by

three different proxies based on Merkley's (2014) dictionary, denoted with the following abbreviations: (i) RD is used for Merkley's dictionary, (ii) RD-FW is used for the combination of Merkley's dictionary with forward looking words and (iii) RD-REDUCED is used for the reduced form of Merkley's dictionary. Models (1) to (3), (4) to (6) and (7) to (9) presented in Table 2.11, include as main explanatory variables the RD narrative proxies derived from textual analysis of 10K filings, Item 1A and Item 7, respectively. Furthermore, all models include RD Expenditure as an additional control variable. This additional control variable is deemed necessary since RD expenditure might be driving any relationship resulting from this analysis. In support of Table's 2.10 findings, these results also show that all three RD narrative disclosures proxies derived from textual analysis of Item 7 (Table 2.11 - Models (7) to (9)) are positively and significantly (p-value<0.01) associated with next year's stock price crash risk. However, this relation is not observed either for the full 10K filings (Table 2.11 - Models (1) to (3)) or the Item 1A (Table 2.11 - Models (4) to (6)). Interestingly, the coefficient with the greater value corresponds to the combination of RD related keywords with forward looking phrases (Model (8)), which is consistent with prior findings on earnings guidance. For instance, Merkley (2014) provide empirical evidence suggesting that when earnings are experiencing a downward trend, firms tend to include more forward-looking words in their 10K filings, in an effort to provide information to help investors evaluate the future. Overall, the results reported in Table 2.11, are supportive to the existence of the managerial rhetoric channel.

**[Insert Table 2.11, here]**

To assess the robustness of the prior findings presented in Table 2.11, all model specifications in Table 2.12 make use of the aggregated set of textual control variables as proposed by prior literature. The analysis performed at this stage, concentrates exclusively to the MD&A section (Item 7). Additionally, all models control for the respective RD related keyword variable that captures the overall research and development text features in the full 10K filing. This control deems necessary for serving the purpose of this study and isolate the impact of the Item 7, by eliminating at the same time the possibility that the results are driven by the content of the entire filing. Importantly, Table 2.12 confirmed that the main findings are insensitive to the model specification. Specifically, the positive relation between RD narrative and stock price crash risk is prevalent among all models and statistically significant (p-value<0.01) to the

inclusion of additional textual control variables and controlling for the RD narrative disclosures within the full 10K filing.

**[Insert Table 2.12, here]**

Following a similar line of reasoning as for the analysis in Table 2.9, the effect of narrative disclosures during post crisis period is being isolated. To test this premise, Table 2.13 includes the interactions of the three proxies of RD disclosures and TONE in Item 7 with the dichotomous variable that indicates the POST CRISIS period.

The results remain unchanged indicating that the same conclusions can be reached also from Table 2.13. Interestingly, while the crisis alters substantially the corporate arena in many aspects, the positive relation between management's narrative disclosures (RD proxies and tone) demonstrated in Table 2.13, remains robust and statistically significant (p-value<0.01).

Overall, the results presented in Tables 2.10, 2.11, 2.12 and 2.13 confirmed the strong influence of MD&A (Item 7) in shaping investors' expectations. The findings suggest that MD&A is employed as a vital conduit through which managers convey information to the investment community. This analysis foreshadows the effectiveness of the business storytelling approach as an impression management tool tailored to influence public, as per an illustrative case of MD&As.

**[Insert Table 2.13, here]**

# 5 Conclusion

This study revisits the vital managerial role and its association with future firm-specific stock price crash risk. The empirical findings propose that the CEO-crash relationship is still characterized by persistent results. Specifically, the findings suggest that firms with younger managers are more vulnerable in experiencing stock price crashes, while more ably managed firms are less prone to future stock price crashes. Additionally, the results reveal that CEOs' incentives to maximize their labour market visibility are related with higher future crash frequencies. The empirical findings are not eradicated by the inclusion of the agency-based channels and endures in the wake of financial crisis.

Furthermore, this study investigates the time-varying relationship between the stock price crash risk and the agency-based channels, opacity and overinvestment. SOX and financial crisis serve as natural experimental settings which enables the examination of the

persistence of the two agency-based channels. Overall, the results indicate that both channels had weakened. Although overinvestment channel has endured over time, the financial crisis debilitates its effect.

Remarkably, this study propounds a new channel through which managers convey information to the stakeholders. The empirical findings suggest that the positive text features prevailing over the negative and research and development keywords, both derived from textual analysis from Management's Discussion and Analysis are positively associated with future stock price crash risk. The results endure in the wake of financial crisis and withstand controls for the RD narrative disclosures, the tone within the full 10K filings and the inclusion of several textual control variables. This new vital conduit is defined as the managerial rhetoric channel through which managers shape investors' expectation.

Additionally, this study examines the alternative measures and cut-off points that are being used by researchers in the firm-specific stock price crash literature. The measures differ in three aspects; the one is their type which can be either binary or continuous, the second one is the model specification (market, industry indexes and number of lead/lag terms) and the third one is the different threshold used to classify a week as a "crash/jump week". Although the alternative measures are used interchangeably by the literature, it is observed that even if the threshold does not induce any significant differences in the recognition of crashes, the inclusion of the value-weighted industry index in the model is crucial, since a part of the crashes occurred can be explained by industry movements. Finally, this study proposes an "unalloyed" measure of stock price crash, namely *pure crash*, that *de*contaminates the measure from crashes that can be counterbalanced by subsequent or preceding jumps.

# 6 Appendix-Chapter 2

**Variable Definitions**

| Variable | Definition |
|---|---|
| **Panel A:** Dependent variables | |
| CRASH (3.09-M) / CRASH (3.2-M) | An indicator variable set equal to one if a firm experiences one or more crash weeks during a fiscal year, and zero otherwise.<br>A "crash week" is, when the firm-specific weekly returns fall at least 3.09/3.2 standard deviations below the average firm-specific weekly return value during the fiscal year. The firm-specific weekly returns are estimated as W= ln $[1 + e_w]$, where $e_w$ is the residual from the following equation:<br>$r_w = a + b_1 r_{m,w-2} + b_2 r_{m,w-1} + b_3 r_{m,w} + b_4 r_{m,w+1} + b_5 r_{m,w+2} + e_w$<br>where $r_{m,w}$ is the value-weighted market return in week *w*. The residuals are estimated by including all available market and firm-related weekly returns, with a minimum number of 26 weeks. |
| CRASH (3.09-MI) / CRASH (3.2-MI) | An indicator variable set equal to one if a firm experiences one or more crash weeks during a fiscal year, and zero otherwise.<br>A "crash week" is, when the firm-specific weekly returns fall at least 3.09/3.2 standard deviations below the average firm-specific weekly return value during the fiscal year. The firm-specific weekly returns are estimated as $W = \ln [1 + e_w]$, where $e_w$ is the residual from the following equation:<br>$r_w = a + b_1 r_{m,w-2} + b_2 r_{m,w-1} + b_3 r_{m,w} + b_4 r_{m,w+1} + b_5 r_{m,w+2} + b_6 r_{i,w-2} + b_7 r_{i,w-1} + b_8 r_{i,w} + b_9 r_{i,w+1} + b_{10} r_{i,w+2} + e_w$<br>where $r_{m,w}$ is the value-weighted market return in week *w* and $r_{i,w}$ is the Fama and French value-weighted industry return. The residuals are estimated by including all available market and firm-related weekly returns, with a minimum number of 26 weeks. |
| **Panel B:** Agency-based Channels | |
| Opacity | Following Hutton, Marcus, and Tehranian (2009), opacity is measured as the prior three years' moving sum of the absolute value of discretionary accruals (*DACC*), where *DACC* is measured as follows:<br>$DACC_t = \frac{TA_t}{ASSETS_{t-1}} - (\widehat{a_0}\frac{1}{ASSETS_{t-1}} + \widehat{b_1}\frac{\Delta SALES_t - \Delta RECEIVABLES_t}{ASSETS_{t-1}} + \widehat{b_2}\frac{PPE_t}{ASSETS_{t-1}})$<br>where Total accruals (TA) are estimated as income before extraordinary items, minus cash flow from operating activities adjusted for extraordinary items and discontinued operations and regressed on the following cross-sectional regression equation using the firms in each Fama and French 48 industries for each fiscal year:<br>$\frac{TA_t}{ASSETS_{t-1}} = a_o\frac{1}{ASSETS_{t-1}} + b_1\frac{\Delta SALES_t}{ASSETS_{t-1}} + b_2\frac{PPE_t}{ASSETS_{t-1}} + e_t$<br>where TA denotes total accruals, ASSETS denotes total assets, ΔSALES denotes change in sales, ΔRECEIVABLES denotes change in receivables and PPE denotes property, plant, and equipment. |
| Overinvestment | Overinvestment is measured as the residuals from the following model:<br>$I_{NEWt} = a_o + b_1\frac{V_{AIP}}{MV_{t-1}} + b_2 LEV_{t-1} + b_3 CASH_{t-1} + b_4 AGE_{t-1} + b_5 SIZE_{t-1} + b_6 STOCK\ RETURN_{t-1} + b_7 I_{NEWt-1} + e_t$<br>where $V_{AIP}$ denotes the value of assets in place and is measured as:<br>$V_{AIP} = (1 - ar)BV + (1 + r)OI - arD$ |

| | |
|---|---|
| | where $BV$ is the book value given by common ordinary equity, $OI$ is the operating income after depreciation, $D$ is annual dividends, $r$=12% (Richardson, 2006) and $a = AEP/(1 + r - AEP)$ where AEP is the abnormal earnings persistence parameter from the Ohlson (1995) framework and equal 0.62, $MV$ is the market value of equity, $LEV$ is the sum of debt in current liabilities and long-term debt divided by book value of equity, $CASH$ is the balance of cash and short term investments deflated by total assets at the start of the year, $AGE$ is the natural logarithm of the number of years that the firm is covered in the Compustat universe, $SIZE$ is the natural logarithm of total assets at fiscal year-end and $STOCK\ RETURN$ is the stock returns for the year prior to the investment year.<br><br>$I_{NEW}$ is the difference between $I_{TOTAL}$ and $I_{MAINTENANCE}$ where $I_{TOTAL}$ denotes the total investment expenditure and is measured as the sum of capital expenditure, acquisition expenditure and research and development expenditure less cash receipts from sale of property, plant, and equipment and $I_{MAINTENANCE}$ denotes the investment expenditure necessary to maintain assets in place and is measured as the depreciation and amortization.<br><br>$I_{NEW}$ is decomposed into the expected investment expenditure in new positive NPV projects, and abnormal/unexpected investment. The abnormal/unexpected investment, which can be either negative/positive denotes the underinvestment/overinvestment. |
| **Panel C:** Variables related to CEO characteristics | |
| CEO Overconfidence | An indicator variable set equal to one if the CEO is classified as overconfident, and zero otherwise (following Campbell, Gallmeyer, Johnson, Rutherford and Stanley, 2011). |
| CEO Age | The natural logarithm of CEO age. |
| CEO Power | An indicator variable set equal to one if the CEO is also the president and the chairman of the firm, and zero otherwise. |
| Managerial Ability | The residuals from the following equation:<br>$Firm\ Efficiency_t = a_o + b_1 Ln(Assets_t) + b_2 Market\ Share_t +$<br>$b_3\ Free\ Cash\ Flow\ Indicator_t + b_4\ Business\ Concentration_t +$<br>$b_5\ Foreign\ Currency\ Indicator_t + e_t$<br>where *Firm Efficiency* is the firm's return on assets minus the industry's median return on assets, *Market Share* refers to the sales of the firm over the total sales of all firms in each industry, *Free Cash Flow Indicator* is set equal to 1 when a firm has nonnegative free cash flow (defined as earnings before depreciation and amortization (OIBDP) less the change in working capital (RECT+INVT+ ACO−LCO−AP) less capital expenditures (CAPX)), *Business Concentration* is the sum of the square market share of all the firms in an industry and *Foreign Currency Indicator* is set equal to one when a firm reports a nonzero value for foreign currency adjustment (FCA). |
| Female CEO | An indicator variable set equal to one if the CEO is female, and zero otherwise. |
| **Panel D:** Variables related to CEO incentives | |
| Stock Incentives | The CEO stock holdings incentives ratio estimated as in Bergstresser and Philippon (2006). |
| Option Incentives | The CEO option holdings incentives ratio estimated as in Bergstresser and Philippon (2006). |
| CITI | Following Coles, Li, and Wang (2018), it is defined as the natural logarithm of the difference between the total compensation (TDC1) of the second highest paid CEO in the same size (proxied by sales) adjusted Fama-French 48 industry group and the total compensation (TDC1) of the firm's CEO. |

| **Panel E:** Variables related to time events | |
|---|---|
| POST SOX | An indicator variable set equal to one between fiscal years 2003 and 2007, and zero otherwise. |
| CRISIS | An indicator variable set equal to one between fiscal years 2008 and 2012, and zero otherwise. |
| POST CRISIS | An indicator variable set equal to one between fiscal years 2013 and 2017, and zero otherwise. |

| **Panel F:** Variables related to textual analysis | |
|---|---|
| Tone | The percentage of the difference between the positive words and the negative words (following the Loughran and McDonald, 2011 dictionary). |
| RD | The percentage of sentences with RD related keywords (following Merkley, 2014 dictionary). |
| RD-FW | The percentage of sentences with RD related keywords combined with forward-looking words (following Merkley, 2014 dictionary). |
| RD-REDUCED | The percentage of sentences with RD related keywords using the reduced set of 6 keywords (following Merkley, 2014 dictionary). |
| Uncertainty | The percentage of words conveying uncertainty (following the Loughran and McDonald, 2011 dictionary). |
| Modal Weak | The percentage of the modal weak words (following the Loughran and McDonald, 2011 dictionary). |
| Litigious | The percentage of the words related to litigation (following the Loughran and McDonald, 2011 dictionary). |
| Size 10K | The natural logarithm of the file size in megabytes of the SEC EDGAR "complete submission text file" for the 10K filing. |

| **Panel G:** Main Control Variables | |
|---|---|
| Size | The natural logarithm of total assets. |
| Firm Age | The natural logarithm of the number of years that the firm is covered in the Compustat universe. |
| Market To Book | The ratio of market value to book value of equity. |
| Leverage | The ratio of total liabilities to total assets. |
| ROE | The ratio of income before extraordinary items to equity. |
| Return | Average firm-specific weekly returns during the fiscal year. |
| Dturn | The detrended average weekly stock trading volume during the fiscal year. |
| NCSKEW | The negative of the third moment of firm-specific weekly returns ($w$) divided by the standard deviation of firm-specific weekly returns raised to the third power, as in the following equation: $$NCSKEW = -[n(n-1)^{\frac{3}{2}} \sum w^3]/[(n-1)(n-2)(\sum w^2)^{\frac{3}{2}}]$$ where n is the number of daily stock returns in the period. |
| CEO Departure | An indicator variable set equal to one if there is a CEO departure in firm's CEO, during the fiscal year *t*, and zero otherwise. |

# 7 Tables-Chapter 2

**Table 2. 1.** Percentages of annual stock prices crashes

This table reports the percentages of annual stock prices crashes and pure stock prices crashes, using different model specifications for the estimation of firm-specific weekly returns and/or thresholds to define a week as a "crash/jump week". With regards to model specifications, the expanded model utilized include either only the market index (M) or both the market and the industry (MI) index with two lead and lag terms of each. Both Panels A and B demonstrate the percentages derived from employing the Market model specification, and the Market-Industry model specification. The threshold for the estimations in Panel A is 3.09 standard deviations, while the threshold in Panel B is 3.2 standard deviations. These statistics are obtained using a sample with sufficient data to estimate the main control variables, which consists of 2,443 firms, with 27,828 firm-year observations.

| | | **Panel A-Threshold 3.09 standard deviations** | | | | **Panel B-Threshold 3.2 standard deviations** | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **N** | **% of Crashes (M)** | **% of Pure Crashes (M)** | **% of Crashes (MI)** | **% of Pure Crashes (MI)** | **% of Crashes (M)** | **% of Pure Crashes (M)** | **% of Crashes (MI)** | **% of Pure Crashes (MI)** |
| 1992 | 724 | 16.71% | 15.75% | 15.88% | 15.61% | 13.54% | 12.85% | 12.29% | 12.15% |
| 1993 | 863 | 17.25% | 15.63% | 14.00% | 12.85% | 14.47% | 13.54% | 12.38% | 11.92% |
| 1994 | 930 | 17.63% | 16.56% | 15.38% | 14.73% | 14.41% | 13.87% | 12.80% | 12.37% |
| 1995 | 989 | 18.38% | 17.47% | 15.86% | 15.15% | 15.66% | 15.15% | 14.04% | 13.54% |
| 1996 | 1054 | 18.94% | 17.90% | 15.72% | 15.34% | 14.77% | 14.11% | 13.35% | 12.97% |
| 1997 | 1101 | 19.98% | 18.53% | 14.90% | 13.71% | 16.71% | 15.62% | 12.62% | 11.90% |
| 1998 | 1092 | 17.49% | 16.30% | 15.66% | 14.84% | 15.48% | 14.93% | 13.19% | 12.82% |
| 1999 | 1071 | 22.69% | 21.57% | 19.79% | 19.05% | 18.95% | 18.30% | 16.53% | 16.25% |
| 2000 | 1056 | 22.65% | 21.33% | 18.86% | 18.10% | 19.72% | 18.77% | 16.49% | 16.02% |
| 2001 | 1101 | 24.91% | 23.55% | 21.00% | 19.73% | 22.09% | 21.36% | 17.64% | 16.91% |
| 2002 | 1119 | 20.75% | 19.23% | 19.05% | 17.44% | 17.98% | 16.91% | 16.19% | 15.30% |
| 2003 | 1204 | 23.86% | 21.78% | 20.78% | 19.12% | 20.86% | 19.62% | 17.96% | 17.04% |
| 2004 | 1187 | 26.56% | 24.03% | 24.11% | 22.43% | 23.52% | 21.84% | 21.16% | 20.07% |
| 2005 | 1147 | 27.62% | 24.48% | 24.30% | 22.81% | 24.56% | 22.38% | 22.20% | 21.07% |
| 2006 | 1165 | 22.10% | 19.60% | 18.66% | 17.28% | 19.17% | 17.45% | 15.91% | 15.22% |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2007 | 1249 | 27.05% | 24.88% | 23.27% | 21.67% | 23.11% | 21.83% | 19.42% | 18.70% |
| 2008 | 1193 | 21.21% | 19.20% | 18.61% | 17.77% | 17.94% | 16.85% | 15.76% | 15.26% |
| 2009 | 1138 | 20.76% | 18.21% | 18.47% | 16.45% | 18.38% | 16.36% | 15.22% | 13.72% |
| 2010 | 1125 | 23.29% | 21.16% | 21.33% | 19.64% | 19.82% | 18.84% | 17.87% | 17.07% |
| 2011 | 1117 | 29.01% | 26.41% | 24.89% | 22.38% | 25.87% | 24.08% | 21.93% | 20.68% |
| 2012 | 1092 | 28.39% | 26.01% | 24.36% | 22.16% | 24.45% | 22.71% | 20.60% | 19.05% |
| 2013 | 1088 | 28.49% | 25.00% | 20.96% | 19.49% | 24.82% | 22.33% | 17.74% | 16.64% |
| 2014 | 1058 | 28.54% | 25.05% | 22.78% | 20.51% | 25.52% | 22.97% | 19.00% | 17.30% |
| 2015 | 998 | 30.76% | 25.55% | 27.66% | 24.35% | 27.86% | 24.55% | 23.65% | 21.54% |
| 2016 | 989 | 34.88% | 30.43% | 30.03% | 27.00% | 30.94% | 27.81% | 26.90% | 24.57% |
| 2017 | 978 | 33.44% | 29.04% | 29.45% | 26.48% | 30.57% | 27.91% | 25.87% | 23.82% |
| **Total** | **27828** | **23.97%** | **21.72%** | **20.61%** | **19.08%** | **20.81%** | **19.34%** | **17.64%** | **16.69%** |

**Table 2. 2. Pearson Correlation**

This table reports the Pearson correlation coefficients between all the various crash and pure crash measures, sing different model specifications for the estimation of firm-specific weekly returns and/or thresholds to define a week as a "crash/jump week". With regards to model specifications, the expanded model utilized include either only the market index (M) or both the market and the industry (MI) index with two lead and lag terms of each. Both Panels A and B demonstrate the percentages derived from employing the Market model specification, and the Market-Industry model specification. The threshold for the estimations in Panel A is 3.09 standard deviations, while the threshold in Panel B is 3.2 standard deviations. For convenience in presenting the results, the threshold-model specification is included in the parentheses. These statistics are obtained using a sample with sufficient data to estimate the main control variables, which consists of 2,443 firms, with 27,828 firm-year observations. All correlation coefficients in Panel A are statistically significant (*p*-value<0.01).

**Panel A: Pearson Correlation - Crash Measures**

| | **CRASH (3.09-M)** | **CRASH (3.2-M)** | **CRASH (3.09-MI)** | **CRASH (3.2-MI)** | **PURE CRASH (3.09-M)** | **PURE CRASH (3.2-M)** | **PURE CRASH (3.09-MI)** | **PURE CRASH (3.2-MI)** |
|---|---|---|---|---|---|---|---|---|
| **CRASH (3.09-M)** | 1 | | | | | | | |
| **CRASH (3.2-M)** | 0.913 | 1 | | | | | | |
| **CRASH (3.09-MI)** | 0.675 | 0.681 | 1 | | | | | |
| **CRASH (3.2-MI)** | 0.667 | 0.686 | 0.909 | 1 | | | | |
| **PURE CRASH (3.09-M)** | 0.938 | 0.859 | 0.643 | 0.637 | 1 | | | |
| **PURE CRASH (3.2-M)** | 0.872 | 0.955 | 0.658 | 0.663 | 0.903 | 1 | | |
| **PURE CRASH (3.09-MI)** | 0.643 | 0.652 | 0.953 | 0.870 | 0.664 | 0.672 | 1 | |
| **PURE CRASH (3.2-MI)** | 0.644 | 0.664 | 0.879 | 0.967 | 0.656 | 0.679 | 0.902 | 1 |

**Panel B: Pearson Correlation - Crash Measures – Agency-Based Channels**

| | **CRASH (3.09-M)** | **CRASH (3.2-M)** | **CRASH (3.09-MI)** | **CRASH (3.2-MI)** | **PURE CRASH (3.09-M)** | **PURE CRASH (3.2-M)** | **PURE CRASH (3.09-MI)** | **PURE CRASH (3.2-MI)** | **Opacity** | **Overinvestment** |
|---|---|---|---|---|---|---|---|---|---|---|
| **CRASH (3.09-M)** | 1 | | | | | | | | | |
| **CRASH (3.2-M)** | 0.913*** | 1 | | | | | | | | |
| **CRASH (3.09-MI)** | 0.675*** | 0.681*** | 1 | | | | | | | |
| **CRASH (3.2-MI)** | 0.667*** | 0.686*** | 0.909*** | 1 | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **PURE CRASH (3.09-M)** | 0.938*** | 0.859*** | 0.643*** | 0.637*** | 1 | | | | | |
| **PURE CRASH (3.2-M)** | 0.872*** | 0.955*** | 0.658*** | 0.663*** | 0.903*** | 1 | | | | |
| **PURE CRASH (3.09-MI)** | 0.643*** | 0.652*** | 0.953*** | 0.870*** | 0.664*** | 0.672*** | 1 | | | |
| **PURE CRASH (3.2-MI)** | 0.644*** | 0.664*** | 0.879*** | 0.967*** | 0.656*** | 0.679*** | 0.902*** | 1 | | |
| **Opacity** | 0.012* | 0.012** | 0.003 | 0.008 | 0.004 | 0.008 | -0.002 | 0.004 | 1 | |
| **Overinvestment** | 0.010 | 0.010* | 0.000 | 0.003 | 0.013** | 0.012** | 0.001 | 0.006 | 0.076*** | 1 |

**Table 2. 3.** Summary Statistics

This table reports summary statistics for the dependent variables, the agency-based channels, the variables related to CEO-incentives, CEO-characteristics, 10K filings and the main and other control variables. These statistics are obtained using a sample with sufficient data to estimate the main control variables, which consists of 2,443 firms, with 27,828 firm-year observations covering the period 1992-2018. The crash risk measures (CRASH and PURE CRASH) feature measurements in fiscal year $t + 1$, whereas all the other variables feature measurements in fiscal year $t$. The sample compromises of data drawn from three databases: Center for Research in Security Prices (CRSP), Execucomp and Compustat. The variables related to 10K filings derived from textual analysis. All continuous variables are winsorized at the 1st and 99th percentile. Detailed variable definitions are provided in the Appendix.

| Variable | Mean | Std Dev | 25th Pctl | Median | 75th Pctl |
|---|---|---|---|---|---|
| **Panel A: Dependent Variables** | | | | | |
| **CRASH (3.09-M)** | 0.241 | 0.428 | 0 | 0 | 0 |
| **CRASH (3.2-M)** | 0.209 | 0.407 | 0 | 0 | 0 |
| **CRASH (3.09-MI)** | 0.207 | 0.405 | 0 | 0 | 0 |
| **CRASH (3.2-MI)** | 0.177 | 0.382 | 0 | 0 | 0 |
| **PURE CRASH (3.09-M)** | 0.218 | 0.413 | 0 | 0 | 0 |
| **PURE CRASH (3.2-M)** | 0.195 | 0.396 | 0 | 0 | 0 |
| **PURE CRASH (3.09-MI)** | 0.192 | 0.394 | 0 | 0 | 0 |
| **PURE CRASH (3.2-MI)** | 0.168 | 0.374 | 0 | 0 | 0 |
| **Panel B: Agency-based Channels** | | | | | |
| **Opacity** | 0.187 | 0.220 | 0.082 | 0.135 | 0.223 |
| **Overinvestment** | 0.044 | 0.210 | -0.068 | 0.009 | 0.103 |
| **Panel C: Variables Related to CEO Incentives** | | | | | |
| **Stock Incentives** | 0.172 | 0.218 | 0.032 | 0.087 | 0.214 |
| **Option Incentives** | 0.162 | 0.167 | 0.042 | 0.112 | 0.228 |
| **CITI** | 8.390 | 2.878 | 8.311 | 9.225 | 9.865 |
| **Panel D: Variables Related to CEO Characteristics** | | | | | |
| **CEO Overconfidence** | 0.422 | 0.494 | 0 | 0 | 1 |
| **CEO Age** | 55.904 | 7.435 | 51 | 56 | 61 |
| **CEO Power** | 0.728 | 0.445 | 0 | 1 | 1 |
| **Managerial Ability** | -3.539 | 9.706 | -4.723 | -1.288 | -0.063 |
| **Female CEO** | 0.023 | 0.150 | 0 | 0 | 0 |
| **Panel E: Variables Related To 10K Filings** | | | | | |
| **Tone 10K** | -0.829 | 0.458 | -1.124 | -0.839 | -0.548 |
| **Tone Item1A** | -0.002 | 0.002 | -0.003 | -0.001 | 0 |
| **Tone Item7** | -0.001 | 0.002 | -0.002 | -0.001 | 0 |
| **RD 10K** | 0.918 | 1.404 | 0.085 | 0.444 | 1.242 |
| **RD-FW 10K** | 0.539 | 0.912 | 0.044 | 0.237 | 0.703 |
| **RD-REDUCED 10K** | 0.704 | 1.01 | 0 | 0.327 | 1.026 |
| **RD Item1A** | 2.063 | 3.73 | 0 | 1.294 | 2.941 |
| **RD-FW Item1A** | 1.267 | 2.593 | 0 | 0.713 | 1.81 |
| **RD-REDUCED Item1A** | 1.449 | 3.28 | 0 | 0.806 | 2.151 |
| **RD Item7** | 1.156 | 2.687 | 0 | 0 | 1.316 |
| **RD-FW Item7** | 0.66 | 1.942 | 0 | 0 | 0.669 |
| **RD-REDUCED Item7** | 0.97 | 2.309 | 0 | 0 | 1.11 |

| | | | | | |
|---|---|---|---|---|---|
| **Panel F: Main Control Variables** | | | | | |
| **Size** | 7.331 | 1.581 | 6.184 | 7.193 | 8.367 |
| **Firm Age** | 2.760 | 0.547 | 2.485 | 2.833 | 3.178 |
| **Market To Book** | 3.193 | 3.633 | 1.551 | 2.377 | 3.785 |
| **Leverage** | 0.509 | 0.213 | 0.363 | 0.513 | 0.643 |
| **ROE** | 0.100 | 0.295 | 0.048 | 0.119 | 0.187 |
| **Return** | -0.127 | 0.136 | -0.156 | -0.081 | -0.043 |
| **Dturn** | 0.001 | 0.018 | -0.006 | 0.000 | 0.007 |
| **NCSKEW** | 0.094 | 0.784 | -0.363 | 0.035 | 0.470 |
| **3Y Before** | 0.076 | 0.264 | 0 | 0 | 0 |
| **2Y Before** | 0.088 | 0.283 | 0 | 0 | 0 |
| **1Y Before** | 0.096 | 0.295 | 0 | 0 | 0 |
| **CEO Departure** | 0.101 | 0.301 | 0 | 0 | 0 |
| **1Y After** | 0.090 | 0.286 | 0 | 0 | 0 |
| **Panel G: Additional Control Variables** | | | | | |
| **Uncertainty** | 1.194 | 0.338 | 0.932 | 1.196 | 1.44 |
| **Modal Weak** | 0.486 | 0.18 | 0.362 | 0.475 | 0.595 |
| **Litigious** | 1.649 | 0.863 | 0.949 | 1.441 | 2.195 |
| **Size 10K** | 14.546 | 1.708 | 13.036 | 14.292 | 16.293 |
| **RD Expenditure** | 0.032 | 0.053 | 0 | 0.005 | 0.042 |

**Table 2. 4. Agency-based channels and stock price crashes (3.09-M)**

This table reports logit regression estimates for the relationship between Overinvestment and Opacity, with one-year ahead stock price crashes. Models (1) to (3) report regression results for CRASH (3.09-M), while Models (4) to (6) report regression results for PURE CRASH (3.09-M*)*, respectively. The threshold for the estimations is 3.09 standard deviations. The dependent variables are measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. Detailed variable definitions are provided in the Appendix. The estimates include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All models include a constant and baseline control variables. The standard errors are clustered at the firm level and provided in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **CRASH (3.09-M)** | | | **PURE CRASH (3.09-M)** | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Overinvestment | 0.055*** | | 0.056*** | 0.060*** | | 0.061*** |
| | (0.01) | | (0.01) | (0.01) | | (0.02) |
| Opacity | | 0.010 | 0.001 | | 0.019 | 0.008 |
| | | (0.03) | (0.03) | | (0.04) | (0.04) |
| Opacity SQ | | -0.014 | -0.008 | | -0.055 | -0.047 |
| | | (0.02) | (0.02) | | (0.05) | (0.05) |
| Size | -0.071*** | -0.060*** | -0.071*** | -0.059*** | -0.048** | -0.061*** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Firm Age | -0.078*** | -0.080*** | -0.078*** | -0.070*** | -0.072*** | -0.070*** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Market To Book | 0.013 | 0.013 | 0.013 | 0.027* | 0.027* | 0.027* |
| | (0.01) | (0.01) | (0.01) | (0.02) | (0.02) | (0.02) |
| Leverage | 0.001 | 0.007 | 0.001 | -0.005 | 0.000 | -0.006 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| ROE | 0.037** | 0.034** | 0.037** | 0.037** | 0.035** | 0.038** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Stock Return | 0.038** | 0.036** | 0.038** | 0.048** | 0.046** | 0.048** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Dturn | 0.043*** | 0.045*** | 0.043*** | 0.039** | 0.041*** | 0.039** |
| | (0.01) | (0.01) | (0.01) | (0.02) | (0.02) | (0.02) |
| NCSKEW | 0.056*** | 0.056*** | 0.056*** | 0.057*** | 0.056*** | 0.056*** |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) |
| 3Y Before | 0.031 | 0.030 | 0.031 | 0.040 | 0.039 | 0.041 |
| | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) |
| 2Y Before | 0.244*** | 0.242*** | 0.244*** | 0.284*** | 0.282*** | 0.284*** |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| 1Y Before | 0.251*** | 0.249*** | 0.252*** | 0.246*** | 0.243*** | 0.247*** |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| CEO Departure | 0.069 | 0.063 | 0.069 | 0.078 | 0.071 | 0.078 |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| 1Y After | -0.053 | -0.062 | -0.053 | -0.058 | -0.068 | -0.058 |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| Year FE | YES | YES | YES | YES | YES | YES |
| Industry FE | YES | YES | YES | YES | YES | YES |
| Number of Observations | 27828 | 27828 | 27828 | 27828 | 27828 | 27828 |
| Pseudo Likelihood | -15000.57 | -15007.64 | -15000.43 | -14297.71 | -14303.55 | -14295.32 |
| Pseudo R2 | 0.023 | 0.023 | 0.023 | 0.020 | 0.020 | 0.021 |
| Mean VIF | 1.14 | 1.39 | 1.36 | 1.14 | 1.39 | 1.36 |

**Table 2. 5. Agency-based channels and stock price crashes (3.09-MI)**

This table reports logit regression estimates for the relationship between Overinvestment and Opacity, with one-year ahead stock price crashes. Models (1) to (3) report regression results for CRASH (3.09-MI), while Models (4) to (6) report regression results for PURE CRASH (3.09-MI), respectively. The threshold for the estimations is 3.09 standard deviations. The dependent variables are measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. Detailed variable definitions are provided in the Appendix. The estimates include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All models include a constant and baseline control variables. The standard errors are clustered at the firm level and provided in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **CRASH (3.09-MI)** | | | **PURE CRASH (3.09-MI)** | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Overinvestment | 0.031** | | 0.032** | 0.030* | | 0.032** |
| | (0.02) | | (0.02) | (0.02) | | (0.02) |
| Opacity | | -0.006 | -0.012 | | 0.004 | -0.002 |
| | | (0.03) | (0.03) | | (0.04) | (0.04) |
| Opacity SQ | | -0.036 | -0.032 | | -0.076 | -0.071 |
| | | (0.04) | (0.04) | | (0.06) | (0.06) |
| Size | -0.091*** | -0.088*** | -0.094*** | -0.081*** | -0.078*** | -0.085*** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Firm Age | -0.065*** | -0.067*** | -0.066*** | -0.057*** | -0.059*** | -0.058*** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Market To Book | 0.017 | 0.018 | 0.018 | 0.026 | 0.027 | 0.027 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Leverage | 0.016 | 0.019 | 0.017 | 0.013 | 0.017 | 0.014 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| ROE | 0.006 | 0.005 | 0.006 | 0.013 | 0.011 | 0.013 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Stock Return | 0.049** | 0.045** | 0.046** | 0.047** | 0.043** | 0.044** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Dturn | 0.057*** | 0.058*** | 0.057*** | 0.051*** | 0.052*** | 0.051*** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| NCSKEW | 0.050*** | 0.049*** | 0.049*** | 0.046*** | 0.045*** | 0.045*** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 3Y Before | -0.044 | -0.044 | -0.043 | -0.025 | -0.025 | -0.024 |
| | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) |
| 2Y Before | 0.247*** | 0.246*** | 0.247*** | 0.246*** | 0.245*** | 0.246*** |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| 1Y Before | 0.330*** | 0.330*** | 0.331*** | 0.297*** | 0.297*** | 0.298*** |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| CEO Departure | 0.075 | 0.072 | 0.076 | 0.049 | 0.046 | 0.050 |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| 1Y After | -0.043 | -0.047 | -0.042 | -0.051 | -0.055 | -0.050 |
| | (0.05) | (0.05) | (0.05) | (0.06) | (0.05) | (0.06) |
| Year FE | YES | YES | YES | YES | YES | YES |
| Industry FE | YES | YES | YES | YES | YES | YES |
| Number of Observations | 27828 | 27828 | 27828 | 27828 | 27828 | 27828 |
| Pseudo Likelihood | -13880.85 | -13880.30 | -13878.10 | -13346.90 | -13343.95 | -13341.90 |
| Pseudo R2 | 0.022 | 0.022 | 0.022 | 0.018 | 0.018 | 0.018 |
| Mean VIF | 1.14 | 1.39 | 1.36 | 1.14 | 1.39 | 1.36 |

**Table 2. 6. Agency-based channels and stock price crashes over time**

This table reports logit regression estimates and the respective marginal effects for the relationship between Overinvestment and Opacity over time, *i.e.* before and after the events of SOX and CRISIS, with one-year ahead stock price crashes. Model (1) reports results for PURE CRASH (3.09-M), while Model (2) reports results for PURE CRASH (3.09-MI), along with their marginal effects. The threshold for the estimations is 3.09 standard deviations. The dependent variables are measured in fiscal year t+1, whereby all independent variables are measured in fiscal year *t*. Detailed variable definitions are provided in the Appendix. The estimates include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All models include a constant and baseline control variables. The standard errors are clustered at the firm level and provided in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **PURE CRASH (3.09-M)** | | **PURE CRASH (3.09-MI)** | |
|---|---|---|---|---|
| | (1) | Marginal Effect (1) | (2) | Marginal Effect (2) |
| Overinvestment | 0.110*** | 0.018*** | 0.064** | 0.010** |
| | (0.02) | (0.00) | (0.03) | (0.00) |
| Opacity | 0.031 | 0.005 | -0.030 | -0.005 |
| | (0.04) | (0.01) | (0.04) | (0.01) |
| Opacity SQ | -0.046 | -0.008 | -0.085 | -0.013 |
| | (0.06) | (0.01) | (0.07) | (0.01) |
| POST SOX | 0.635*** | 0.106*** | 0.460*** | 0.070*** |
| | (0.12) | (0.02) | (0.13) | (0.02) |
| Overinvestment x POST SOX | -0.077** | -0.013** | -0.010 | -0.002 |
| | (0.04) | (0.01) | (0.04) | (0.01) |
| Opacity x POST SOX | -0.008 | -0.001 | 0.061 | 0.009 |
| | (0.05) | (0.01) | (0.06) | (0.01) |
| CRISIS | 0.740*** | 0.123*** | 0.545*** | 0.083*** |
| | (0.13) | (0.02) | (0.13) | (0.02) |
| Overinvestment x CRISIS | -0.106*** | -0.018*** | -0.054 | -0.008 |
| | (0.04) | (0.01) | (0.04) | (0.01) |
| Opacity x CRISIS | -0.027 | -0.004 | 0.045 | 0.007 |
| | (0.04) | (0.01) | (0.05) | (0.01) |
| POST CRISIS | 0.967*** | 0.161*** | 0.844*** | 0.128*** |
| | (0.13) | (0.02) | (0.13) | (0.02) |
| Overinvestment x POST CRISIS | -0.062 | -0.010 | -0.098** | -0.015** |
| | (0.04) | (0.01) | (0.04) | (0.01) |
| Opacity x POST CRISIS | -0.075 | -0.012 | 0.036 | 0.006 |
| | (0.05) | (0.01) | (0.06) | (0.01) |
| Year FE | YES | | YES | |
| Industry FE | YES | | YES | |
| Baseline Controls | YES | | YES | |
| Number of Observations | 27828 | | 27828 | |
| Pseudo Likelihood | -14289.91 | | -13338.17 | |
| Pseudo R2 | 0.021 | | 0.019 | |
| Mean VIF | 1.77 | | 1.77 | |

**Table 2. 7. CEO characteristics, CEO incentives and stock price crashes**

This table reports logit regression estimates for the relationship between CEO characteristics and incentives, with one-year ahead stock price crashes. All models are regressed on PURE CRASH (3.09-MI) as a dependent variable. Models (1) and (2) include variables related to CEO incentives, while Models (3) to (7) include variables related to CEO characteristics. The threshold for the estimations is 3.09 standard deviations. The dependent variable is measured in fiscal year $t$+1, whereby all independent variables are measured in fiscal year $t$. Detailed variable definitions are provided in the Appendix. The estimates include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All models include a constant and baseline control variables. The standard errors are clustered at the firm level and provided in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **PURE CRASH (3.09-MI)** | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Option Incentives | 0.047** | | | | | | |
| | (0.02) | | | | | | |
| Stock Incentives | 0.023 | | | | | | |
| | (0.02) | | | | | | |
| CITI | | 0.091*** | | | | | |
| | | (0.02) | | | | | |
| CEO Overconfidence | | | 0.005 | | | | |
| | | | (0.04) | | | | |
| CEO Age | | | | -0.040** | | | |
| | | | | (0.02) | | | |
| Managerial Ability | | | | | -0.059*** | | |
| | | | | | (0.02) | | |
| CEO Power | | | | | | 0.044 | |
| | | | | | | (0.04) | |
| Female CEO | | | | | | | 0.139 |
| | | | | | | | (0.10) |
| Year FE | YES | YES | YES | YES | YES | YES | YES |
| Industry FE | YES | YES | YES | YES | YES | YES | YES |
| Baseline Controls | YES | YES | YES | YES | YES | YES | YES |
| Number of Observations | 23782 | 27458 | 22755 | 27727 | 27828 | 27828 | 27828 |
| Pseudo Likelihood | -12226.36 | -14126.60 | -11829.66 | -14267.62 | -14302.39 | -14305.33 | -14304.90 |
| Pseudo R2 | 0.021 | 0.020 | 0.021 | 0.020 | 0.020 | 0.020 | 0.020 |
| Mean VIF | 1.19 | 1.14 | 1.15 | 1.16 | 1.15 | 1.14 | 1.13 |

**Table 2. 8. CEO characteristics, CEO incentives, agency-based channels and stock price crashes**

This table reports logit regression estimates for the relationship between CEO characteristics and incentives, with one-year ahead stock price crashes, at the inclusion of the agency-based channels in the analysis. All models are regressed on PURE CRASH (3.09-MI) as a dependent variable. Models (1) and (2) include variables related to CEO incentives, while Models (3) to (7) include variables related to CEO characteristics. The threshold for the estimations is 3.09 standard deviations. The dependent variable is measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. Detailed variable definitions are provided in the Appendix. The estimates include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All models include a constant and baseline control variables. The standard errors are clustered at the firm level and provided in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **PURE CRASH (3.09-MI)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Option Incentives | 0.046** | | | | | | | 0.047** | | 0.058** |
| | (0.02) | | | | | | | (0.02) | | (0.02) |
| Stock Incentives | 0.023 | | | | | | | 0.023 | | 0.022 |
| | (0.02) | | | | | | | (0.02) | | (0.02) |
| CITI | | 0.091*** | | | | | | 0.086*** | | 0.076*** |
| | | (0.02) | | | | | | (0.02) | | (0.02) |
| CEO Overconfidence | | | 0.003 | | | | | | 0.007 | -0.029 |
| | | | (0.04) | | | | | | (0.04) | (0.04) |
| CEO Age | | | | -0.039** | | | | | -0.046** | -0.039* |
| | | | | (0.02) | | | | | (0.02) | (0.02) |
| Managerial Ability | | | | | -0.057*** | | | | -0.050** | -0.045** |
| | | | | | (0.02) | | | | (0.02) | (0.02) |
| CEO Power | | | | | | 0.044 | | | 0.054 | 0.037 |
| | | | | | | (0.04) | | | (0.05) | (0.05) |
| Female CEO | | | | | | | 0.142 | | 0.102 | 0.038 |
| | | | | | | | (0.10) | | (0.11) | (0.12) |
| Overinvestment | 0.022 | 0.029* | 0.018 | 0.031** | 0.030* | 0.033** | 0.033** | 0.021 | 0.015 | 0.010 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| Opacity | 0.017 | -0.003 | 0.018 | -0.005 | -0.002 | -0.001 | -0.002 | 0.016 | 0.015 | 0.019 |
| | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| Opacity SQ | -0.086 | -0.067 | -0.078 | -0.068 | -0.070 | -0.072 | -0.071 | -0.084 | -0.074 | -0.075 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (0.07) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.07) | (0.06) | (0.06) |
| Year FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry FE | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Baseline Controls | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Number of Observations | 23782 | 27458 | 24160 | 22755 | 27727 | 27828 | 27828 | 27828 | 27602 | 18050 |
| Pseudo Likelihood | -11410.25 | -13171.79 | -11529.28 | -11068.71 | -13304.97 | -13337.33 | -13341.27 | -13340.84 | -13219.01 | -8822.33 |
| Pseudo R2 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.019 | 0.018 | 0.018 | 0.020 | 0.017 |
| Mean VIF | 1.42 | 1.37 | 1.53 | 1.4 | 1.39 | 1.38 | 1.37 | 1.37 | 1.36 | 1.43 |

**Table 2. 9. CEO characteristics, CEO incentives and stock price crashes – POST CRISIS**

This table reports logit regression estimates for the relationship between CEO characteristics and incentives, with one-year ahead stock price crashes, by isolating their effect during POST CRISIS period. All models are regressed on PURE CRASH (3.09-MI) as a dependent variable. Models (1) and (2) include variables related to CEO incentives, while Models (3) and (4) include variables related to CEO characteristics. The threshold for the estimations is 3.09 standard deviations. The dependent variable is measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. Detailed variable definitions are provided in the Appendix. The estimates include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All models include a constant and baseline control variables. The standard errors are clustered at the firm level and provided in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **PURE CRASH (3.09-MI)** | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Option Incentives | 0.079*** | | | |
| | (0.02) | | | |
| Option Incentives x POST CRISIS | -0.123*** | | | |
| | (0.04) | | | |
| Stock Incentives | -0.007 | | | |
| | (0.06) | | | |
| Stock Incentives x POST CRISIS | 0.023 | | | |
| | (0.02) | | | |
| CITI | | 0.089*** | | |
| | | (0.02) | | |
| CITI x POST CRISIS | | 0.011 | | |
| | | (0.04) | | |
| Managerial Ability | | | -0.047** | |
| | | | (0.02) | |
| Managerial Ability x POST CRISIS | | | -0.103** | |
| | | | (0.05) | |
| CEO Age | | | | -0.041** |
| | | | | (0.02) |
| CEO Age x POST CRISIS | | | | 0.009 |
| | | | | (0.04) |
| POST CRISIS | 0.726*** | 0.755*** | 0.865*** | 0.809*** |
| | (0.16) | (0.14) | (0.13) | (0.13) |
| Year FE | YES | YES | YES | YES |
| Industry FE | YES | YES | YES | YES |
| Baseline Controls | YES | YES | YES | YES |
| Number of Observations | 23782 | 27458 | 27828 | 27727 |
| Pseudo Likelihood | -11410.553 | -13177.929 | -13341.748 | -13311.607 |
| Pseudo R2 | 0.019 | 0.019 | 0.018 | 0.018 |

**Table 2. 10. Tone of 10K filings and stock price crashes**

This table reports logit regression estimates for the relationship between the tone of 10K filings, with one-year ahead stock price crashes. All models are regressed on PURE CRASH (3.09-MI) as a dependent variable. The threshold for the estimations is 3.09 standard deviations. The dependent variable is measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. Detailed variable definitions are provided in the Appendix. The estimates include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All models include a constant and baseline control variables. The standard errors are clustered at the firm level and provided in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **PURE CRASH (3.09-MI)** | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Tone Item1A | 0.043 | | 0.046 | | 0.047 | |
| | (0.03) | | (0.03) | | (0.03) | |
| Tone Item7 | | 0.073*** | | 0.073*** | | 0.075*** |
| | | (0.02) | | (0.02) | | (0.02) |
| Tone 10K | 0.029 | 0.017 | 0.029 | 0.014 | 0.034 | 0.020 |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) |
| Uncertainty | | | | | 0.041 | 0.047 |
| | | | | | (0.05) | (0.05) |
| Modal Weak | | | 0.006 | -0.011 | -0.015 | -0.036 |
| | | | (0.03) | (0.03) | (0.04) | (0.04) |
| Litigious | 0.048* | 0.035 | 0.047* | 0.035 | 0.068* | 0.059* |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.04) | (0.04) |
| Size 10K | 0.053 | 0.065 | 0.053 | 0.065 | 0.056 | 0.069 |
| | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) |
| Year FE | YES | YES | YES | YES | YES | YES |
| Industry FE | YES | YES | YES | YES | YES | YES |
| Baseline Controls | YES | YES | YES | YES | YES | YES |
| Number of Observations | 16231 | 16231 | 16231 | 16231 | 16231 | 16231 |
| Pseudo Likelihood | -7956.140 | -7952.200 | -7956.119 | -7952.123 | -7955.713 | -7951.587 |
| Pseudo R2 | 0.016 | 0.017 | 0.016 | 0.017 | 0.016 | 0.017 |

**Table 2. 11. Research and Development narratives of 10K filings and stock price crashes**

This table reports logit regression estimates for the relationship between Research and Development (RD) narratives, with one-year ahead stock price crashes. All models are regressed on PURE CRASH (3.09-MI) as a dependent variable. Models (1) to (3), (4) to (6) and (7) to (9) include as main explanatory variables RD narrative proxies derived from textual analysis of 10K filings, Item 1A and Item 7, respectively. The threshold for the estimations is 3.09 standard deviations. The dependent variable is measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. Detailed variable definitions are provided in the Appendix. The estimates include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All models include a constant and baseline control variables. The standard errors are clustered at the firm level and provided in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **PURE CRASH (3.09-MI)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| RD 10K | -0.007 | | | | | | | | |
| | (0.03) | | | | | | | | |
| RD-FW 10K | | -0.005 | | | | | | | |
| | | (0.03) | | | | | | | |
| RD-REDUCED 10K | | | -0.009 | | | | | | |
| | | | (0.03) | | | | | | |
| RD Item1A | | | | -0.007 | | | | | |
| | | | | (0.02) | | | | | |
| RD-FW Item1A | | | | | 0.001 | | | | |
| | | | | | (0.02) | | | | |
| RD-REDUCED Item1A | | | | | | -0.007 | | | |
| | | | | | | (0.02) | | | |
| RD Item7 | | | | | | | 0.055*** | | |
| | | | | | | | (0.02) | | |
| RD-FW Item7 | | | | | | | | 0.058*** | |
| | | | | | | | | (0.02) | |
| RD-REDUCED Item7 | | | | | | | | | 0.056*** |
| | | | | | | | | | (0.02) |
| RD Expenditure | -0.029 | -0.029 | -0.028 | -0.030 | -0.032 | -0.031 | -0.057** | -0.055* | -0.055* |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) |
| Industry FE | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Baseline Controls | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Number of Observations | 16231 | 16231 | 16231 | 16231 | 16231 | 16231 | 16231 | 16231 | 16231 |
| Pseudo Likelihood | -7960.399 | -7960.408 | -7960.380 | -7960.380 | -7960.426 | -7960.377 | -7957.494 | -7956.537 | -7957.173 |
| Pseudo R2 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 |

**Table 2. 12. Research and Development narratives of 10K filings and stock price crashes-Robustness checks**

This table reports logit regression estimates for the relationship between Research and Development (RD) narratives, with one-year ahead stock price crashes. All models are regressed on PURE CRASH (3.09-MI) as a dependent variable. Models (1) to (3), (4) to (6) and (7) to (9) include as main explanatory variables RD narrative proxies derived from textual analysis of full 10K filings and Item 7, denoted as RD, RD-FW and RD-REDUCED**,** respectively. The threshold for the estimations is 3.09 standard deviations. The dependent variable is measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. Detailed variable definitions are provided in the Appendix. The estimates include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All models include a constant and baseline control variables. The standard errors are clustered at the firm level and provided in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **PURE CRASH (3.09-MI)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| RD Item7 | 0.078*** | 0.078*** | 0.078*** | | | | | | |
| | (0.03) | (0.03) | (0.03) | | | | | | |
| RD 10K | -0.055 | -0.055 | -0.055 | | | | | | |
| | (0.03) | (0.03) | (0.03) | | | | | | |
| RD-FW Item7 | | | | 0.074*** | 0.074*** | 0.074*** | | | |
| | | | | (0.02) | (0.02) | (0.02) | | | |
| RD-FW 10K | | | | -0.045 | -0.045 | -0.045 | | | |
| | | | | (0.03) | (0.03) | (0.03) | | | |
| RD-REDUCED Item7 | | | | | | | 0.074*** | 0.074*** | 0.074*** |
| | | | | | | | (0.02) | (0.02) | (0.02) |
| RD-REDUCED 10K | | | | | | | -0.046 | -0.046 | -0.046 |
| | | | | | | | (0.03) | (0.03) | (0.03) |
| RD Expenditure | -0.036 | -0.036 | -0.036 | -0.034 | -0.034 | -0.034 | -0.038 | -0.038 | -0.038 |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) |
| Tone 10K | 0.052* | 0.052* | 0.052* | 0.052* | 0.052* | 0.052* | 0.051* | 0.051* | 0.051* |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) |
| Uncertainty | 0.037 | 0.037 | 0.037 | 0.035 | 0.035 | 0.035 | 0.037 | 0.037 | 0.037 |
| | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) | (0.05) |
| Modal Weak | -0.027 | -0.027 | -0.027 | -0.026 | -0.026 | -0.026 | -0.030 | -0.030 | -0.030 |
| | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| Litigious | 0.072** | 0.072** | 0.072** | 0.074** | 0.074** | 0.074** | 0.073** | 0.073** | 0.073** |
| | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) | (0.04) |
| Size 10K | 0.057 | 0.057 | 0.057 | 0.059 | 0.059 | 0.059 | 0.058 | 0.058 | 0.058 |
| | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) | (0.06) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year FE | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry FE | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Baseline Controls | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Number of Observations | 16231 | 16231 | 16231 | 16231 | 16231 | 16231 | 16231 | 16231 | 16231 |
| Pseudo Likelihood | -11410.25 | -13171.79 | -11529.28 | -11068.71 | -13304.97 | -13337.33 | -13341.27 | -13340.84 | -13219.01 |

**Table 2. 13. Tone, Research and Development narratives of 10K filings and stock price crashes - POST CRISIS**

This table reports logit regression estimates for the relationship between Research and Development (RD) narratives and tone of Item 7, with one-year ahead stock price crashes, by isolating their effect during POST CRISIS period. All models are regressed on PURE CRASH (3.09-MI) as a dependent variable. Models (1) to (3) include as main explanatory variables RD narrative proxies derived from textual analysis of Item 7, while Model (4) includes as a main explanatory variable the tone of Item 7. The threshold for the estimations is 3.09 standard deviations. The dependent variable is measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. Detailed variable definitions are provided in the Appendix. The estimates include industry-fixed effects and year-fixed effects to control for unobserved time-invariant effects pertaining to industry and year characteristics, respectively. All models include a constant and baseline control variables. The standard errors are clustered at the firm level and provided in parentheses. All continuous variables are winsorized at the 1st and 99th percentiles and are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **PURE CRASH (3.09-MI)** | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| RD Item7 | 0.080*** | | | |
| | (0.03) | | | |
| RD Item7 x POST CRISIS | -0.072 | | | |
| | (0.05) | | | |
| RD 10K | -0.047 | | | |
| | (0.03) | | | |
| RD-FW Item7 | | 0.075*** | | |
| | | (0.02) | | |
| RD-FW Item7 x POST CRISIS | | -0.100 | | |
| | | (0.06) | | |
| RD-FW 10K | | -0.032 | | |
| | | (0.03) | | |
| RD-REDUCED Item7 | | | 0.076*** | |
| | | | (0.02) | |
| RD-REDUCED Item7 x POST CRISIS | | | -0.061 | |
| | | | (0.06) | |
| RD-REDUCED 10K | | | -0.044 | |
| | | | (0.03) | |
| Tone Item7 | | | | 0.082*** |
| | | | | (0.03) |
| Tone Item7 x POST CRISIS | | | | -0.018 |
| | | | | (0.05) |
| RD Expenditure | -0.035 | -0.035 | -0.036 | |
| | (0.03) | (0.03) | (0.03) | |
| POST CRISIS | 0.457 | 0.464 | 0.454 | 0.442 |
| | (0.35) | (0.35) | (0.35) | (0.35) |
| Tone 10K | 0.053* | 0.052* | 0.052* | 0.019 |
| | (0.03) | (0.03) | (0.03) | (0.03) |
| Uncertainty | 0.036 | 0.035 | 0.037 | 0.048 |
| | (0.05) | (0.05) | (0.05) | (0.05) |
| Modal Weak | -0.026 | -0.025 | -0.028 | -0.036 |
| | (0.04) | (0.04) | (0.04) | (0.04) |
| Litigious | 0.074** | 0.076** | 0.074** | 0.058 |
| | (0.04) | (0.04) | (0.04) | (0.04) |
| Size 10K | 0.056 | 0.058 | 0.057 | 0.069 |
| | (0.06) | (0.06) | (0.06) | (0.06) |
| Year FE | YES | YES | YES | YES |
| Industry FE | YES | YES | YES | YES |
| Baseline Controls | YES | YES | YES | YES |
| Number of Observations | 16231 | 16231 | 16231 | 16231 |
| Pseudo Likelihood | -7951.337 | -7950.356 | -7951.489 | -7951.504 |
| Pseudo R2 | 0.017 | 0.017 | 0.017 | 0.017 |

# Chapter 3

## CEO Departure and Stock Price Crashes: The effects of crepuscular behavior

# 1 Introduction

Managerial short-termism continues to attract the attention of both researchers and practitioners. Executives tend to sacrifice firm's value with the intention to meet short-run earnings targets. Interestingly, 55% of surveyed executives would forgo a positive NPV project if it leads to a decrease in the current quarter's earnings (Graham, Harvey, and Rajgopal, 2005). Managerial short-termism is of an increasing importance, admitting that valuing short-term gains disproportionally higher than long-term, undermines firm performance and growth.

One of the major topics investigated in the field of managerial short-termism is Chief Executive Officers (CEOs) career time horizon. CEOs "have incentives to place lower values on cash flows occurring beyond their horizon" and therefore become more myopic (Jensen and Smith, 2000). Accordingly, during CEOs' last years in office, their incentives to act in the best interest of shareholders are less than if they plan to stay in the firm (Smith and Watts, 1982; Dechow and Sloan, 1991; Cheng, 2004). The main reason is that CEOs' wealth is associated to the current profitability of the firm.

Until recently, a substantial stream of research focuses on investigating the CEO behavior prior to CEO retirement, considering that the escalation of short-termism is especially pronounced prior to CEO retirement. During pre-retirement period, the managerial discretion may be manifested in various management practices such as suboptimal investments, practices of income-increasing earnings, and accounting frauds. The CEO opportunistic behavior becomes a source of agency problems. Does this apply only in years prior to CEO retirement, or generally prior to CEO departure? This study aims to answer this question by investigating CEOs' opportunistic activities in the years prior to their departures, which are not due to retirement exit schemes. If non-close-to-retirement CEOs are myopic then they may have high incentives to enhance their own wealth that is tied to the firm's short-term profitability. Hoarding of bad news is the main mechanism to achieve this goal.

The theoretical development of Jin and Myers (2006) reveals that information asymmetry between managers and shareholders enables the accumulation of bad news, which can be considered as the catalyst for the occurrence of a stock price crash. Accordingly, while existing literature examines CEO behavior prior to CEO retirement, attention is paid to the CEO behavior prior to CEO departure, and its relationship with stock price crashes, which remains largely unexplored.

This study extends the extant literature by relating the occurrence of the firm-specific stock price crashes with the CEO departure. Using 17,902 firm-year observations and 1,939 US listed firms from 1994 to 2016, the study explores the relationship between the CEO departure and firm-specific stock price crashes, after controlling for a large set of firm and CEO related variables. The results show that the occurrence of a stock price crash is heightened prior to the departure of the CEO. Particularly, one and two years before the CEO departure, firms experience 24.5% and 23.9% more stock price crashes than the rest years of CEO tenure.

The findings are consistent with agency theory arguments, suggesting that information asymmetry offers the potential for self-interested behavior by managers (Jin and Myers, 2006). In line with this theory, it is hypothesized that CEOs prior to their departure withhold bad news and act overly opportunistically to extract rents. Accordingly, the accumulation of bad news leads to stock price crashes when the hoarded hidden bad news crosses a tipping point, and thus comes out all at once. This "crepuscular behavior" is consistent with the idea that CEOs in their final years in office hide negative news from investment community to justify their opportunistic behavior. Therefore, it could be stated that the occurrence of the firm-specific stock price crash is the manifestation of CEO's crepuscular behavior.

Other factors may explain this relationship. For example, the behavior of CEOs approaching retirement may drive the results. Hence, the analysis is performed by excluding the CEO departures due to retirements and the occurrence of a stock price crash is still more pronounced prior to CEO departure. Furthermore, the analysis considers not only firm-level control variables, but also variables related to the firm environment and CEO-level characteristics. For instance, prior literature shows that conditional conservatism limits managers' incentives and ability to overstate performance (Kim and Zhang, 2016) and that opaque firms are more prone to stock price crashes (Hutton, Marcus, and Tehranian, 2009; Hong, Kim, and Welker, 2017). Consequently, variables related to quality of earnings are taken into consideration, such as accounting conservatism and opacity, and again the results remain unaffected. Additionally, to alleviate any concerns that the results may be driven by several explanations related to the 10K filings, such as that managers can successfully hide adverse information by writing complex financial reports (Kim, Wang, and Zhang, 2018) the specification controls for the readability of 10K filings and textual measures derived from the 10K filings related to the tone and the size of the filings. This study also considers several alternative interpretations of the findings that can be driven by CEO characteristics. For instance, existing literature shows that firms with overconfident managers (Kim, Wang, and Zhang, 2016) or younger managers (Andreou,

Louca, and Petrou, 2017) are more likely to experience stock price crashes. Therefore, the analysis incorporates several CEO characteristics and compensation variables, such as age, tenure, equity incentives etc. A battery of robustness checks is performed, such as using alternative measures of stock price crash risk and applying alternative empirical specifications, and still obtain consistent results, supporting the hypotheses. The analyses show that the main finding remains strong and is not subsumed by any of the above controls.

The results show that the occurrence of a stock price crash is heightened prior to the departure of the CEO. One might think that the CEO departure is due to the stock price crash or due to bad performance. But is this really the case? To shed more light to this observed phenomenon some additional tests are being performed. It is hypothesized that CEOs in their final years in office hide negative news to justify their opportunistic behavior and at some point, the accumulated bad news releases abruptly leading to a stock price crash. The results support the hypothesis. But why CEOs become myopic prior to their departure? How do they know that they are about to depart the firm? They may not know exactly when they are going to depart the firm, they may not even plan to leave. However, they may be ready to accept the risk of a departure and they may be acting as if they are expecting it. To test this hypothesis, a comparison is performed between the behavior of CEOs in firms that have experienced a CEO departure versus the behavior of CEOs in firms that have not experienced a CEO departure. Therefore, having in mind that CEOs are concerned about firm performance, because it has a direct impact on their current and future personal wealth, the attention is turned on their remuneration packages. Are there any observed patterns between the CEOs years prior to departure and their compensation packages? If the CEOs do not have in mind the departure as a possible scenario that may occur in the subsequent years, then we should not observe any patterns in compensation components.

Each firm that has experienced a CEO departure in any of the three previous years of investigation is matched with a firm that operates in the same two-digit industry, with approximately the same size, that has not experienced a CEO departure in any of the three previous years. The results evince that CEOs in firms that have experienced a CEO departure have a significantly higher number of shares acquired on option exercise and they significantly reduce their options and stock ownership, in comparison with CEOs in their matching firms. This CEO behavior before departure is therefore defined as the “crepuscular behavior”.

In the absence of appropriate monitoring, CEOs might undertake actions that maximize their own wealth to the detriment of shareholders’ welfare. The literature on stock price crash risk,

has related the importance of corporate governance mechanism with the likelihood of crashes. Further analysis examines the association between the CEO departure and the occurrence of a stock price crash, with the quality of various governance mechanism including institutional ownership. Results indicate that crash firms display an improvement in some of the corporate governance mechanisms, i.e. there is a significant increase in the percentage of independent directors, which could be responsible for the revelation of hoarded bad news.

However, in the case of CEO departures, this increase of the percentage of independent directors, as well as the increase of the percentage of independent directors which are also members of the audit committee, happens ex post. The same applies when the investigation considers firms that experience both CEO departures with stock price crashes. More specifically, firms tend to increase monitoring mechanisms by improving their corporate governance after CEO departures with crash, which can be considered either as an effort to restore trust, or as an indication of a learning effect. Therefore, it can be concluded that the occurrence of the stock price crash and the departure in management can be ascribed to the failure of corporate governance to alleviate the agency problems and align the interests between the managers and shareholders. Those harmful for the firm negative events, act as a "shock" for the board to improve the governance control systems to avoid the repetition of such short-termism behavior in the future.

This study provides several contributions to the literature. First, it contributes to the literature on managerial short-termism by documenting the impact of CEO departure on managerial short-termism. Furthermore, it extends prior studies on CEO myopia, such as Dechow and Sloan (1991) and Cheng (2004), but in a different manner. While prior studies focus on CEO retirement, the focus of study's investigation is the period prior to the CEO departure. Additionally, this research provides a beneficial supplement by presenting empirical evidence suggesting that CEOs prior to their departure, withhold bad news and act opportunistically to extract rents. The study identifies a specific timing at which managers have higher incentives to engage in myopic behavior. This observed behavior of CEOs just before their departure is defined as "crepuscular behavior". CEOs, during this period, acquire a higher number of shares from option exercising and significantly reduce their stock ownership. In line with this observed short-termism behavior, this study contributes to the literature of agency theory, by identifying a new agency problem that comes out prior to CEO departure and it can be costly to the firms.

Furthermore, this analysis paints a broader picture about a previously ignored aspect; it is observed that the occurrence of the firm-specific stock price crash is the manifestation of CEO's short-termism behavior. Additionally, this study contributes to the literature on stock price crashes. Recently, a growing body of theoretical and empirical research has emerged examining the factors that drive stock price crashes (see, e.g., Kim, Li, and Zhang, 2011a; Callen and Fang, 2013; Kim, Wang, and Zhang, 2016; Kim and Zhang, 2016; Andreou, Antoniou, Horton, and Louca, 2016; Hong, Kim, and Welker, 2017; Andreou, Louca, and Petrou, 2017). While most of the recent research focuses on the determinants of crash risk, this study is the first so far directly testing the timing of the occurrence of firm-specific stock price crashes. This study enriches the perspectives on CEO departures and is a necessary supplement to the existing literature, since it provides empirical evidence that supports the positive association between the years prior to CEO departures with firm-specific stock price crash risk.

Furthermore, the findings contribute to the literature of corporate governance. This study investigates whether there is an association between corporate governance and stock price crash risk during the CEOs last years in office, by utilizing various corporate governance measures including institutional ownership. The answer to this question can help understanding which governance mechanisms enhance effectiveness, and whether board structure is in a monitoring role. The absence of appropriate monitoring in firms that experienced CEO departures with stock price crashes, constitutes the ideal environment for the manifestation of CEOs' short-termism behavior. However, the empirical finding which shows that the board improved governance mechanisms, at least ex-post, is both empowering and encouraging. This evidence suggests that board monitoring can help address managerial myopia.

Not only does this study have implications for regulators, but it also has implications for the investment community. A more advanced analysis of stock price crash risk could alleviate the devastating impact on investors wealth. It is a beneficial supplement to the literature and can assist investors in making improved investment decisions that intensify their wealth instead of experiencing losses.

The rest of the study is organized as follows. Section 2 discusses related literature and states the main research hypotheses. Section 3 describes the data selection procedure and provides details on the methodological framework. Section 4 illustrates the empirical results, and finally, Section 5 is dedicated to concluding remarks.

## 2 Literature review and hypothesis development

A key source of conflict between CEO's and shareholders, apart from the CEO's choice of how much effort to devote, and their inability to diversify away the risk, is that the decision horizon of CEOs is shorter than the investment horizon of the firm and its owners (Jensen and Smith, 2000). While the firm has an infinite lifespan with shareholders having the right to claim on the entire future stream of firm's earnings, the CEOs' claim on the firm is only limited to their tenure (Antia, Pantzalis, and Park, 2010). A great stream of literature has examined the association between managerial horizon and CEO discretionary choices. Theory states that during CEO's last years in office, the incentives to act in the best interest of shareholders are less than if the manager plans to stay in the firm (Smith and Watts, 1982; Dechow and Sloan, 1991; Cheng, 2004). Based on the argument of Jensen and Smith (2000), CEOs "have incentives to place lower values on cash flows occurring beyond their horizon" and accordingly CEOs become more myopic. Therefore, this timing can be associated with discretionary choices and usage of ill practices, such as earnings management and accounting fraud related techniques, which may have unfavorable and devasting results for the firms' shareholders. Although, there are several studies investigating the CEO behavior prior to retirement, it appears that the CEO behavior prior to departure and its relationship with stock price crash risk remains largely unexplored.

Previous literature shows that CEOs' opportunism is an important determinant of short-termism (Antia, Pantzalis, and Park, 2010). In this vein, literature documents a phenomenon commonly referred to as the horizon problem. Dechow and Sloan (1991) provide empirical evidence showing that CEOs approaching retirement have incentives to reduce discretionary investments, particularly Research and Development (R&D) expenditures. Although they hypothesize that firms reduce the R&D expenditures to enhance earnings performance, they do not find any evidence that the reduction in R&D expenditure is related with poor firm performance. In the same manner, Ali and Zhang (2015) show that in cases of a predetermined departure, e.g. CEO retirement, after controlling for earnings overstatement in their early years of service, where the CEOs are trying to reveal their ability to the investment community, they observe more intensive overstatement of earnings in the CEOs' final year.

However, empirical research on the relation between departing CEOs and their discretionary practices prior to retirement remains inconclusive. For instance, Murphy and Zimmerman (1993) show that in firms with strong performance there is no evidence of managerial discretion prior to CEO retirement. This finding leads them to ascribe the changes in discretionary choices

on poor performance. Moreover, Cheng (2004) provides no evidence between CEO departure and R&D expenditures and Bizjak, Brickley, and Coles (1993) findings do not support the hypothesis that CEOs approaching retirement are more likely to forgo long-term investments. Remarkably, Mannix and Loewenstein (1994) by utilizing a laboratory experiment demonstrate that departing managers tend to emphasize more on short-term payoffs. Similarly, Davidson, Xie, Xu, and Ning (2007) postulate that firms with CEOs that are about to retire are appeared to have more discretionary accruals during the pre-departure year. Kalyta (2009), conditionally supports this hypothesis, by providing evidence of the usage of income-increasing earnings management practices during pre-retirement period, only when the pension of the manager is tied to firms' performance.

During last several decades, there is a substantially increasing attention to the importance of the CEO in the corporate context. Based on the aforementioned arguments, it could be stated that the CEO can use judgment in abundant ways to make a specific decision that affects the value of the firm and consequently the wealth of shareholders. Some examples they may include accounting choices, can affect financial reporting or either investment decisions. Even if some cases have already been reviewed, numerous other studies exist in which the CEOs may choose to exploit their favorable position at the firm to act opportunistically. Taking for granted that managers have information superior to that of the market, allows firms to be at least temporarily overvalued (Shivakumar, 2000). Largely, in the presence of informational asymmetry, agency problems may arise which cause managers to serve their personal interests by pursuing short-term outcomes, at the expense of the long-term ones. Based on this argument, the information asymmetry that exists between corporate top executives and shareholders provides the ideal conditions needed for the occurrence of a stock price crash (Jin and Myers, 2006).

The research on stock price crash risk from the firm-specific view, postulates that stock price crashes have a higher probability to occur among firms with high agency risk (Callen and Fang, 2013; Kim and Zhang, 2016) and happen when the investment community suddenly realizes that the stock prices were overstated. In firms with high agency risks, CEOs due to career concerns may exploit information asymmetries to manifest self-interested behavior and hide bad news by being engaged in actions that result in short-sighted price maximization (Stein, 1989). A rather vast body of empirical literature on the topic of stock price crash risk is built primarily upon the agency theory that enables the accumulation of bad news, which can be

considered as the catalyst for the occurrence of a stock price crash (Habib, Hasan, and Jiang, 2018).

For instance, existing literature provides evidence suggesting that stock price crash risk is positively related to accounting opacity (Hutton, Marcus, and Tehranian, 2009; Hong, Kim, and Welker, 2017) and negatively related to conditional conservatism (Kim and Zhang, 2016). Specifically, the first empirical research on stock price crash risk by Hutton, Marcus, and Tehranian (2009), examines the association between the transparency of financial reporting and stock return distribution. They show that opacity is related with higher R2's, which is an indication of lower flow of firm-specific information to the market and hence, opaque firms are more susceptible to experience stock price crashes. On the other hand, conditional conservatism, which mainly refers to the asymmetric propensity of accountants being more assured to accept the positive news as gains than the negative as losses (Basu, 1997), can mitigate the likelihood of withholding negative news or overstate positive news (Kothari, Ramanna, and Skinner, 2010). Specifically, Kim and Zhang (2016) show that conditional conservatism limits managers' incentives and ability to overstate performance. However, managers can conceal adverse information by writing complex financial reports and therefore the readability of 10K filings is inversely related to the probability of a stock price crash occurrence (Kim, Wang, and Zhang, 2018).

Another stream of literature on stock price crash risk, examines the relationship between CEO characteristics and stock price crash risk. For instance, existing literature shows that firms with overconfident managers (Kim, Wang, and Zhang, 2016) overestimate their investment choices and therefore deny forgoing negative NPV projects resulting in an accumulation of bad performance and consequently to the occurrence of a stock price crash. Additionally, Andreou, Louca, and Petrou (2017) provide empirical evidence that younger managers have incentives, tied to their personal wealth, to withhold negative news in the early stages of their career and therefore are more likely to experience stock price crashes. Furthermore, Habib and Hasan (2017) examine the impact of managerial ability on stock price crash risk and document evidence suggesting that more able CEOs make suboptimal investment choices, specifically they over-invest, leading the firm to be more vulnerable to a stock price crash.

The burgeoning literature on stock price crashes focuses primarily on the determinants of stock price crashes. Prior studies rigorously investigate numerous determinants of stock price crashes. However, while the occurrence of a stock price crash is time incident, no previous research has assessed the timing of stock price crashes. This study extends the current line of

research on stock price crashes by relating the occurrence of the stock price crash with the CEO departure. The study draws motivation from prior literature built on the horizon problems and agency theory arguments suggesting that information asymmetry offers the potential for self-interested behavior by managers (Jin and Myers, 2006). Therefore, it is expected that CEOs before departure withhold negative information to extract rents and justify their opportunistic behavior. Accordingly, the accumulation of bad news lead to stock price crashes when the hoarded hidden bad news crosses a tipping point, and thus comes out all at once. Consequently, it is expected that:

Hypothesis 1: The occurrence of a stock price crash is heightened during the years prior to the departure of the CEO.

Kothari, Shu, and Wysocki (2009) argue that insiders tend to withhold negative news for prolonged period, denying their flow into the stock market and this will eventually lead to an accumulation of bad news within the firm and to severe stock overvaluation. However, there is a critical point at which the continuation of hoarding of bad news is not only too costly for the CEOs, but also impossible (Baik, Farber, and Lee, 2011). At this point, the revelation of negative information, leads the investment community to revise its expectations about the firm and consequently the occurrence of a stock price crash risk is inevitable (Jin and Myers, 2006). This may occur in cases when the CEO chooses to withhold negative news from the investors, when confronted with outcomes that may have an adverse effect on their wealth (Gibbons and Murphy, 1992; Bliss and Rosen, 2001).

As the two functions of ownership and control are separated, conflict of interest may arise between the top executives and the shareholders. While managers are selected by the owners to make decisions based on shareholders' best interests, this is not always the case (see, e.g., Jensen and Meckling, 1976; Shleifer and Vishny, 1989). The interest of top executives may differ from the primary goal of shareholders which is wealth maximization. This conflict of interest, known as agency problem, which arises when the agent decides on the behalf of the principal, results from information asymmetry, i.e. the fact that the agent always knows more than the principal. In this situation, managers have information superior to that of the market, and allow firms to be at least temporarily overvalued (Shivakumar, 2000).

Although a considerable body of literature views stock-based compensation as a way to mitigate agency problems between managers and shareholders, there is also empirical evidence suggesting that it might also lead to earnings management. CEOs are extremely concerned about firm performance because it has a direct impact on their current and future personal

wealth through their remuneration packages (Gibbons and Murphy, 1992; Bliss and Rosen, 2001; Petrou and Procopiou, 2016). Therefore, CEOs have incentives to conceal the negative information from the market to preserve the level of stock price by maintaining their expectations. Another related line of work examines the relation between insider trading and earnings management and provide empirical results that CEOs adjust discretionary accruals when they intend to sell off their partial ownership in the subsequent years (Park and Park, 2004). Moreover, Marinovic and Varas (2019) state that compensation may become very sensitive to short-term performance and this creates an "endogenous horizon problem" leading CEOs escalating performance manipulation during their final years in office. Furthermore, the model proposed by Benmelech, Kandel, and Veronesi (2010) shows that the stock-based compensation itself may encourage CEOs to willingly overstate prices and be aware of the forthcoming crash. Accordingly, it is expected to observe a relationship during the years prior to the CEO departure and some specific components of their compensation. Therefore, it is hypothesized that:

Hypothesis 2: CEOs exercise their options and reduce their firm's share ownership in the years prior to the CEO departure.

# 3 Research design

## 3.1 Sample selection

The sample compromises of the intersection of data from the Center for Research in Security Prices (CRSP), Execucomp and Compustat. The initial sample consists of 45,026 firm-year observations for all US firms listed. The sample satisfies the data requirements to compute the main variables of interest i.e. Stock price crash and CEO departure. Then, the following selection criteria are imposed: First, the crash risk measures computed from CRSP, exclude firm-years with a stock price less than $1 at the end of fiscal year and firm-years with fewer than 26 weeks of stock returns in a fiscal year. Additionally, the observations with missing data for the main control variables are excluded and remain with 35,445 firm-year observations. The inclusion of firm related variables leads to 22,706 firm-year observations. The firm-year observations where CEOs are also founders are also excluded.[5] For the remaining firms, the

[5] Firm specific stock price crash risk mainly arises from an agency perspective of withholding bad news, which also stems from suboptimal investment decisions and use accounting practices to show an inaccurately overstated

CEO related data are gathered from Execucomp ending up with 17,902 firm-year observations. Overall, the filtering rule and the inclusion of all the variables leads to the omission of financial service firms (SIC 6000-6999) and utilities (SIC 4900-4999), consistently with prior research. The final sample, with insufficient data to calculate the variables used in the regressions, thus consists of 17,902 firm-year observations between 1994 (the explanatory variables are lagged by one year) and 2016, which correspond to 1,939 firms from various industries.

## 3.2 Dependent variables

Literature defines stock price crash risk at the firm level, as the probability of observing extreme negative values in the distribution of firm-specific returns (Jin and Myers, 2006; Kim, Li, and Zhang, 2011a, b). The bulk of the empirical literature uses the following measures of firm specific stock price crashes, which are based on firm-specific weekly returns. The firm-specific weekly returns are estimated as the residuals from the following expanded model:

$$r_{j,w} = a_j + b_{1,j}r_{m,w-2} + b_{2,j}r_{m,w-1} + b_{3,j}r_{m,w} + b_{4,j}r_{m,w+1} + b_{5,j}r_{m,w+2} + b_{6,j}r_{i,w-2} + b_{7,j}r_{i,w-1} + b_{8,j}r_{i,w} + b_{9,j}r_{i,w+1} + b_{10,j}r_{i,w+2} + e_{j,w} \quad (1)$$

where $r_{j,w}$ is the return on stock j in week w, and $r_{i,w}$ is the Fama and French value-weighted industry index and $r_{m,w}$ is the value-weighted market index in that week, as obtained from CRSP database. The model includes lead and lag variables to allow for non-synchronous trading (Dimson, 1979). Additionally, the model (1) focuses on firm-specific factors rather than market or industry. This serves the aim of the study to investigate the determinants of stock price crash risk by focusing on the residuals from the regression.

The firm-specific weekly returns for firm j in week t $(W_{j,w})$ as estimated as follows:

$$W_{j,w} = \ln(1 + e_{j,w}) \quad (2)$$

To estimation of the above equations, requires at least 26 weekly observations, so the sample in restricted into those fiscal years.

The first measure of stock price crash risk is a crash indicator variable that takes the value of 1 if the firm j has experienced one or more crash weeks during the fiscal year t, and zero otherwise (CRASH). A week is defined as a "crash week", when the firm-specific weekly

performance of the firm. A founder CEO has invested her/his human capital on the business and has no incentives to apply any of the prementioned ways to alter the real image of the business, since he/she will be the first that is going to suffer from the consequences.

returns fall at least 3.2 standard deviation below the average firm-specific weekly return value in year t, similar to Kim, Li, and Zhang (2011a).

The second measure, negative coefficient of skewness, has been proposed by Chen, Hong, and Stein, (2001), denoted as NCSKEW. It is calculated by taking the negative of the third moment of firm-specific weekly returns and dividing it by the standard deviation of firm-specific weekly returns raised to the third power. Thus, for any stock j in year t:

$$NCSKEWj,t = -(n(n-1)^{\frac{3}{2}} \sum w_{j,t}^3)/((n-1)(n-2)(\sum w_{j,t}^2)^{\frac{3}{2}}) \quad (3)$$

where $w_{j,t}$ represents the sequence of weekly returns to stock j during year t, and n is the number of observations on weekly returns during the year.

## 3.3 Main explanatory variables

The main explanatory variable is the CEO Departure (CEO Departure). CEO Departure is measured using an indicator variable set equal to one if there is a departure in firm's CEO, during the fiscal year t, and zero otherwise. The study focuses on years prior to CEO Departure. Therefore, indicator variables are set equal to one if we refer to one fiscal year before the year of the CEO departure, two fiscal years before the year of the CEO departure and three fiscal years before the year of the CEO departure, denoted as 1Y Before, 2Y Before and 3Y Before, respectively. All explanatory and control variables are described in the Appendix.

## 3.4 Control Variables

The analysis includes numerous control variables proposed by literature as having a predictive power in explaining the occurrence of a stock price crash. More specifically, the specifications incorporate firm-level control variables, variables related to the firm environment and CEO-level variables related to their characteristics and their compensation. As far as firm-level variables are concerned, all model specifications include the main variables that control for Leverage, the ratio of total liabilities to total assets; Market to Book, the ratio of market value to book value of equity; Return on Equity, the ratio of income before extraordinary items to equity; Size, the natural logarithm of total assets at fiscal year-end; and Firm Age, the number of years that the firm is covered in the Compustat universe. Furthermore, the analysis controls for detrended turnover (Dturn), the detrended average weekly stock trading volume during the fiscal year; which captures time-varying impacts on skewness, and past returns (Stock Return), average firm-specific weekly returns during the fiscal year (Chen, Hong, and Stein, 2001).

Smaller firms, younger firms with less experience, firms with high growth, firms with less profits and more leverage are expected to be more prone to experience a stock price crash. Furthermore, firms with higher past returns are appeared to have a more negative skewness (Harvey and Siddique, 2000). Endogeneity concerns are circumvented by the inclusion of lag values of the negative coefficient of skewness (NCSKEW). In additional tests, conducted to assess the robustness of findings, NCSKEW is utilized as the depended variable. The empirical specifications include Fama-French 48 industry-fixed effects and year fixed effects to control for idiosyncratic differences between industries and unobserved year characteristics, respectively.

Furthermore, the inclusion of Conservatism and Opacity variables is conceived to control for the quality of earnings. Prior literature showed that conditional conservatism limits managers' incentives and ability to overstate performance (Kim and Zhang, 2016) and that opaque firms are more prone to stock price crashes (Hutton, Marcus, and Tehranian, 2009; Hong, Kim, and Welker, 2017). Additionally, textual measures derived from the 10K filings are also taken into consideration based on Kim, Wang, and Zhang (2018) study which shows that managers can successfully hide adverse information by writing complex financial reports. Specifically, the study controls for the readability of 10K filings (10K Readability) and other variables related to the 10K filings, such as the size of the filings (10K Size), the natural logarithm of the gross 10K filing size; 10K N_Words, proxied by the natural logarithm of the number of words in the 10K filings; Negative Tone and Positive Tone; as the percentage of words in the 10K with negative or positive tone respectively [following the Loughran and McDonald (2011) dictionary]. Moreover, the regression models include variables related to the Financial Constraints as per Hadlock and Pierce (2010) and Altman's (1968) Z-Score as a proxy for the probability of bankruptcy.

In addition, variables related to firm environment are also being conceived, with the inclusion of the Herfindahl-Hirschman index (HHI), the sum of the square market share of all the firms in an industry, where a value close to zero is an indicator of a highly competitive environment and Competitiveness, the industry adjusted price-cost margin which is defined as the ratio of firm operating profit to sales. Regarding the firm-level environment, this study proposes the inclusion of a variable that has been ignored by prior literature, the Peer Information. As in recent work by Shroff, Verdi, and Yost (2017), information environment of peer firms, considered as publicly available firm-specific information, has an impact on the cost of capital for other firms in the industry. Similarly, the inclusion of this variable in the analysis, can be

considered as an additional proxy for firms' transparency. Since similar economic forces affect firms operating in the same industry, peer disclosures have spillover effects that decrease information asymmetry between CEOs and shareholders, for all firms operating in that industry (Shroff, Verdi, and Yost, 2017). Accordingly, since peer information can reduce opacity (i.e. increase transparency) and firm-specific component, a negative association between peer's information and the probability of experiencing a stock price crash it is subsequently expected.

Several variables related to CEO characteristics and compensation are also taken into consideration. Existing literature shows that firms with overconfident managers (Kim, Wang, and Zhang, 2016) overestimate their investment choices and therefore deny forgoing negative NPV projects resulting in an accumulation of bad performance and consequently to the occurrence of a stock price crash. Andreou, Louca and Petrou (2017) provide empirical evidence that younger managers have incentives, tied to their personal wealth, to withhold negative news in the early stages of their career and therefore are more likely to experience stock price crashes. Therefore, the analysis incorporates CEO Overconfidence as proposed by Campbell, Gallmeyer, Johnson, Rutherford, and Stanley (2011) and CEO Age. Additionally, to capture the CEO firm specific experience and knowledge related to their tenure (Hambrick and Fukutomi, 1991), the models include two indicator variables Short CEO Tenure and Long CEO Tenure that are set equal to one if the CEO has tenure less than 3 years (short) or the CEO has tenure more than 8 years (long) respectively, and zero otherwise. Along with the implication of gender on asset prices, the analysis also considers the CEO gender variable (Li and Zeng, 2019). Furthermore, Habib and Hasan (2017) examined the impact of managerial ability on stock price crash risk and document evidence suggesting that more able CEOs make suboptimal investment choices, specifically they over-invest, leading the firm more vulnerable to a stock price crash. Accordingly, the regression analysis incorporates the Managerial Ability measure derived from Demerjian, Lev, Lewis, and McVay (2012). Likewise, increased managerial incentives and ability to overstate performance are captured by the CEO power (Dual CEO) indicator variable, which is set equal to one if the CEO is also the chairman of the firm, and zero otherwise. Given that the focus of this study is on the years prior to CEO departure, variables related to the CEO turnover, such as the Retirement and Forced Turnover, are included to isolate the effect of study's interest compared to behaviors related to the horizon problem. Additionally, Kim, Li, and Zhang (2011a) investigated the relationship between top executives' equity incentives and stock price crash risk and found a weak positive relation between CEOs' incentives and stock price crash risk. There is also evidence suggesting that CEO stock option incentives increase stock price crash risk (Andreou, Antoniou, Horton, and

Louca, 2016). Accordingly, the empirical analysis includes CEO Stock Incentives and CEO Option Incentives using the CEO stock, and option respectively, holdings incentives ratio estimated as in Bergstresser and Philippon (2006). Finally, the analysis also considers CEO Ownership, the sum of the number of shares owned (options excluded), the unexercised exercisable options, the unexercised unexercisable options and the restricted stock holdings over the total number of firm's common shares outstanding; and Bonus to Salary.

# 4 Empirical results

## 4.1 Summary statistics

Table 3.1 reports annual statistics for stock price crashes and CEO departures. The sample consists of 17,902 firm-year observations covering the period 1994-2016, of which 3,841 firm-years or 21.27% are classified as crashes. Table 3.1 shows that more recent years are more prone to stock price crashes, similarly to the mean value of 25.4% reported in Li and Zeng (2019), who employ a more recent, albeit smaller, sample period (2007-2016). The average weekly return of crashes during the sample period equals -18.12%. During the sample period, there are 1,769 CEO departures or 9.95%. The yearly mean CEO departure rate remains approximately the same across the sample period of investigation.

**[Insert Table 3.1, here]**

Table 3.2 presents summary statistics for all the variables used in the empirical analysis, based on the sample of firm-years with non-missing observations for the control variables. The mean value (standard deviations) of CEO departure is 0.099 (0.298). The 9.95% sample yearly mean CEO departure rate is close to the 9.63% CEO departure rate of public firms [reported in Gao, Harford, and Li (2017)]. Table 3.2 reports that the mean value (standard deviations) of CRASH is 0.215 (0.411), suggesting that about 22% of firm-years demonstrate at least one crash event. The mean value (standard deviations) of NCSKEW variable is 0.108 (0.796). The means and standard deviations of the crash risk measures are comparable to those reported in prior studies (see, e.g., Kim, Li, and Zhang, 2011a; Andreou, Antoniou, Horton and Louca, 2016). The distribution characteristics of other variables are largely consistent with those reported in previous empirical studies. For instance, the average firm in this sample has a size of 7.3 (1.547), natural logarithm of firm age of 2.922 (0.731), market to book ratio of 3.352 (3.348) and leverage of 0.288 (0.229). The sample firms have a mean (standard deviation) return on equity of 0.096 (0.229) and an average firm-specific weekly return of -0.131 (0.144). The

detrended average weekly stock trading volume is 0.983 (18.862) and the mean (standard deviation) negative coefficient of skewness of 0.102 (0.776).

**[Insert Table 3.2, here]**

## 4.2 Univariate analysis

Figure 3.1 illustrates the evolution of stock price crashes surrounding CEO departures. It is observed that the occurrence of a stock price crash is heightened in the years prior and during the departure of the CEO. Particularly, one and two years prior to the CEO departure, firms experience 23.84% and 23.23% stock price crashes, while the sample average frequency is 21.46%. To alleviate any concerns that results are driven by the behavior of CEOs approaching retirement Figure 3.1 plots the evolution of stock price crashes surrounding CEO departures, after excluding the departures due to retirements. There are 248 CEO departures that are due to retirements, at the year of CEO departure. Remarkably, the trend is even stronger, with firms demonstrating 24.69% and 23.42% stock price crashes, one and two years prior to the CEO departure, respectively. Notwithstanding, the occurrence of a stock price crash is still more pronounced the years prior to the CEO departure.

**[Insert Figure 3.1, here]**

## 4.3 Baseline regression analysis

The following empirical analysis investigates the relationship between the stock price crash risk and CEO departure in a multivariate regression. Firstly, a logit regression analysis (Table 3.3-Models (1) and (2)) is employed, where the dependent variable is the CRASH and the main explanatory variables are CEO departure, 1Y Before, 2Y Before, 3Y Before and 1Y After.

The baseline panel model is as follows:

$$Crash_{j,t+1} = a_j + b_1 3Y\ Before_j + b_2 2Y\ Before_j + b_3 1Y\ Before_j + b_4 CEO\ Departure_j + b_5 1Y\ After_j + Industry\ FE + Year\ FE + e_{j,t} \quad (4)$$

Regression models include Fama-French 48 industry fixed effects (Industry FE) (Fama and French, 1997), year fixed effects (Year FE) and models (2), (4) and (6) take into account control variables. All models include a constant and the standard errors are clustered at the firm-year level. All continuous variables are z-score standardized to have a mean value of zero and variance of one to put all variables on a common scale. Table 3.3, model (1) shows that the odds to experience a stock price crash is heightened by 1.202 (p-value<0.01) and 1.201 (p-value<0.01), respectively one (1Y Before) and two years (2Y Before) prior to the CEO

departure.[6] Table 3.3, model (2) takes into account control variables proposed by prior literature on stock price crashes. It shows that the probability to experience a stock price crash is heightened by 1.223 (p-value<0.01) and 1.219 (p-value<0.01), respectively one (1Y Before) and two years (2Y Before) prior to the CEO departure. Control variables generally have the expected sign. For instance, younger firms and firms with less profits are more prone to experience a stock price crash. There is also a positive and statistically significant relationship between average firm-specific weekly returns, detrended turnover and negative coefficient of skewness with the occurrence of a stock price crash.

The results are similar when the analysis is conducted with the alternative measure of stock price, namely NCSKEW (Models (3) and (4)). Interestingly, in these OLS regression results, with the alternative measure of stock price crash not only the coefficients of one and two years prior to the CEO departure are positive and statistically significant, but also the third year prior to the CEO departure and the year of CEO departure. However, the strongest effect appears on the one and two years prior to the CEO departure. Next, the main control variables are included in the models, as proposed by prior literature. The results, for the alternative measure is presented in model (4) of Table 3.3. The statistically significant results (p-value<0.01) still show that the occurrence of a stock price crash is heightened one and two years prior to the departure of the CEO. Turning next to the control variables, the results in model (4) and (6) show that most control variables affect the probability of a stock price crash significantly. For example, firms with high growth are more prone to experience a stock price crash. Among the control variables, the signs are as expected, except from the leverage coefficient which implies that less leverage are more prone to experience a stock price crash.

**[Insert Table 3.3, here]**

The analysis continues with the inclusion of a large array of control variables to alleviate the possibility of alternative explanations driving the main findings and provide further support for the validity of the hypothesized relationship. For brevity, the results thereinafter are reported only for CRASH and NCSKEW, which are widely used in prior studies. Table 3.4, models (1) and (5) present the results after including variables related to the firm environment. More

[6] Accordingly, the probabilities to experience a stock price crash are heightened by 20.2% (p-value<0.01) and 20.1% (p-value<0.01), respectively one (1Y Before) and two years (2Y Before) prior to the CEO departure.

All logistic regression models report odds ratios (the exponential of each coefficient estimate). Ceteris paribus, odds ratios equal to one indicate no relationship between the dependent variable (CRASH) and each explanatory. Odds ratios greater (less) than one specify the magnitude of increase (decrease) on the probability of experiencing a CRASH.

specifically, the regression analysis includes the Herfindahl-Hirschman index (HHI), Competitiveness and Peer Information. Table 3.4, model (1) shows that the odds to experience a stock price crash is heightened by 1.229 (p-value<0.01) and 1.224 (p-value<0.01), respectively one (1Y Before) and two years (2Y Before) prior to the CEO departure. Concerning the control variables, as it was expected, there is a statistically significant (p-value<0.01) negative association between peer's information and the probability of experiencing a stock price crash. Model (5) presents similar results, while there is also an expected and statistically significant (p-value<0.01) positive association between competitiveness and stock price crash.

Models (2) and (6), listed in Table 3.4, present the results after including variables related to the quality of earnings, Conservatism and Opacity variables. Prior literature showed that conditional conservatism limits managers' incentives and ability to overstate performance (Kim and Zhang, 2016) and that opaque firms are more prone to stock price crashes (Hutton, Marcus and Tehranian, 2009; Hong, Kim and Welker, 2017). Although, the results remain unchanged regarding the main explanatory variables, the two variables related to the quality of earnings are not significant.

Models (3) and (7), listed in Table 3.4, present the results after including textual measures derived from the 10K filings. Kim, Wang, and Zhang (2019) show that managers can successfully hide adverse information by writing complex financial reports. Therefore, readability of 10K filings (10K Readability) and other variables related to the 10K filings, such as the size of the filings (10K Size), 10K N Words, Negative Tone and Positive Tone are also taken into consideration. Logistic regression's results show that less readable 10K filings, filings with negative tone and filings with more words appear to have a positive relation with stock price crash. The results remain again unaffected by the inclusion of the 10K related variables.

Finally, models (4) and (8) include variables related to the Financial Constraints as per Hadlock and Pierce (2010) and Altman's (1968) Z-Score as a proxy for the probability of bankruptcy. In the OLS regression, a higher probability of bankruptcy is associated with higher stock price crashes. One and two years before the CEO departure, firms experience statistically significant (p-value<0.01) more stock price crashes.

**[Insert Table 3.4, here]**

Models (1) and (5), listed in Table 3.5, present the results after including variables related to the CEO characteristics. Andreou, Louca, and Petrou (2017) provide empirical evidence that firms with younger managers are more likely to experience stock price crashes. Furthermore, Habib and Hasan (2017) document evidence suggesting that more able CEOs lead the firm more vulnerable to a stock price crash. Therefore, analysis incorporates CEO Age and Managerial Ability. Additionally, the CEO firm specific experience and knowledge related to their tenure (Hambrick and Fukutomi, 1991) is captured by the inclusion of Short CEO Tenure and Long CEO Tenure. The implication of gender on asset prices is also conceived by including the CEO gender variable (Li and Zeng, 2019) and CEO power (Dual CEO). Firms with younger CEOs and firms one and two years prior to the CEO departure are more likely to experience stock price crashes. Model (1) in Table 3.5 shows that the odds to experience a stock price crash is heightened by 1.257 (p-value<0.01) and 1.249 (p-value<0.01), respectively one (1Y Before) and two years (2Y Before) prior to the CEO departure.

Next, models (2) and (6), include variables related to the CEO compensation. Kim, Li, and Zhang (2011a) investigate the relationship between top executives' equity incentives and stock price crash risk and find a weak positive relation between CEOs' incentives and stock price crash risk. There is also evidence suggesting that CEO stock option incentives increase stock price crash risk (Andreou, Antoniou, Hutton and Louca, 2016). Accordingly, the analysis includes CEO Stock Incentives and CEO Option Incentives. Furthermore, CEO Ownership and Bonus to Salary are also considered. Interestingly, the results suggest a statistically significant (p-value<0.01) positive relationship between stock and option incentives with stock price crashes, while more ownership is associated with less stock price crashes.

Models (3) and (7), include variables related to the CEO turnover, such as the Retirement and Forced Turnover variables, to better isolate the effect of CEO departure on stock price crash from the behaviors related to the horizon problem. Models (4) and (8), include both firm and CEO related variables in a comprehensive model specification. The inclusion of a large array of control variables reduced the sample size to 17,902 observations. Model (4) in Table 3.5 shows that the odds to experience a stock price crash is heightened by 1.245 (p-value<0.01) and 1.239 (p-value<0.01), respectively one (1Y Before) and two years (2Y Before) prior to the CEO departure.

**[Insert Table 3.5, here]**

Table 3.6, although it is the same with Table 3.5 in all aspects, it also includes CEO Overconfidence variable. Existing literature show that firms with overconfident managers (Kim, Wang and Zhang, 2016) overestimate their investment choices and therefore deny forgoing negative NPV projects resulting in an accumulation of bad performance and consequently to the occurrence of a stock price crash. While the results remain unchanged, the CEO Overconfidence variable appears insignificant. The inclusion of CEO Overconfidence reduces substantially the sample to 15,557 observations. The subsequent analysis provided in Table 3.6 and thereinafter excludes CEO Overconfidence to maintain a greater sample of investigation. The results are also robust to the use of a variety of sensitivity checks regarding the model specification.

**[Insert Table 3.6, here]**

## 4.4 Difference-in-differences analysis

To shed more light to the positive relation between the occurrence of stock price crashes and the years prior to CEO departure, it is essential to focus on acquiring an understanding of the behavior of CEOs during their last years in office. CEOs have incentives to conceal negative information from the market to preserve the level of stock price by maintaining their expectations. Presupposing that CEOs are concerned about firm performance because has a direct impact on their current and future personal wealth, the attention is turned on their remuneration packages. The investigation of the second hypothesis begins by plotting the Figure 3.2, with the aim to observe the patterns between the CEOs years prior to departure and their compensation packages. The figures display the mean value for each compensation measure from six years prior to the CEO Departure to one year prior to the CEO departure for both the full sample and the full sample after excluding CEO retirements. Both samples have similar trends. The salary measure shows a growing trend until the fourth year prior to the CEO departure and appears more or less stable during the rest years prior to the CEO departure. The bonus mean value and the total compensation have a decreasing trend as approaching the year of CEO departure. The growing time trend of the number of shares acquired on option exercise reaches the highest level two years prior to the CEO departure, implying that managers choose to exercise their options at this timing. Finally, there is a substantial, decreasing trend of the CEO ownership, the options, the total number of shares, the total number of shares excluding options and the number of unrestricted shares excluding options. This implies that not only managers exercise their options, but they also intend to sell off their partial ownership in the

years prior to their departure. The figures provide some evidence supporting the second hypothesis.

**[Insert Figure 3.2, here]**

However, the difference in crashes between firms with departing CEOs and those with non-departing may be explained by any firm characteristics that can affect CEO departure. In such a case, the positive relation between years prior to CEO departure and the occurrence of a stock price crash is not due to CEO departure as such. When there is a direct comparison of crashes between firms with departing CEOs and firms with non-departing CEOs, a bias may arise due to potential confounding variables. To alleviate the possibility of having biased results, a matched control group is developed. Each firm that has experienced a CEO departure in any of the previous three years of investigation is matched with a firm that operates in the same two-digit industry, with approximately the same size (proxied by sales), that has not experienced a CEO departure in any of the three previous years.

The matching group enables the conduction of a difference-in-differences analysis of various CEO compensation components between the firms that have experienced a CEO departure in any of the three previous years and firms that have not experienced a CEO departure (Table 3.7). The results confirm the graphical representation and provide additional evidence supporting the second hypothesis. There is a higher statistically significant (p-value<0.01) tendency for firms with departing CEOs to experience more stock price crashes. Furthermore, departing CEOs are appeared to have a higher salary, which is reasonable supposing their greater tenure. Additionally, results in Table 3.7 show that CEOs in firms that has experienced a CEO departure have a significantly higher number of shares acquired on option exercise and they reduce significantly their options, their shares (total, unrestricted and shares excluding options) and stock ownership, in comparison with CEOs in their matching firms. This CEO behavior before departure is defined as the “crepuscular behavior”.

**[Insert Table 3.7, here]**

## 4.5 Crash Risk implications on corporate governance

So far, the investigation focuses on the association between CEO departure and the occurrence of stock price crash. Then, the study explores the behavior of CEOs prior to their departure, and its linkage with their compensation packages. At this point, additional analysis is employed

to shed more light to the prior findings, by investigating the environment that enables this short-termism behavior to manifest.

In the absence of appropriate monitoring, CEOs might undertake actions that maximize their own wealth to the detriment of shareholders' welfare. The literature on stock price crashes related the importance of corporate governance mechanism with the likelihood of crashes. Even though CEOs may exploit information asymmetry to manifest self-interested behavior and hide bad news by being involved in actions that result in short-sighted price maximization in firms with high agency risks (Stein, 1989), this behavior is more difficult to be manifested in the presence of proper monitoring. Prior literature suggests that the absence of monitoring, lead CEOs to undertake actions that maximize their own wealth to the detriment of shareholders' welfare. More specifically, Callen and Fang (2013), test the role of institutional investors and provide supporting findings for the monitoring, instead of the short-termism, perspective of their role. Additionally, Andreou, Antoniou, Horton, and Louca (2016) highlight the importance of various corporate governance mechanisms in mitigating stock price crash risk. They mentioned that their findings are stronger in firms with high agency risks. There is also literature indicating that even though fraud firms are appeared to have a poor corporate governance, they take actions to improve their governance after fraud detection (Farber, 2005). Consequently, considering the CEO departure as an important event for a firm, it is expected to observe changes in the monitoring system either ex-post or ex-ante.

The study examines the association between the CEO departure and a stock price crash, with the quality of various governance mechanism including institutional ownership. More specifically, the dependent variables are Independent Directors measured as the number of independent directors divided by the board size, Female Directors measured as the number of female directors divided by the board size, Busy Directors measured as the number of directors who are also members of other Major Company Boards divided by the board size, Audit members measures as the number of independent directors which are also members of the audit committee divided by the board size, Dedicated institutional investors and Transient institutional investors [following the classifications as in Bushee (1998, 2001)].

Table 3.8 presents OLS regression estimates for the relationship between Stock Price Crash risk and corporate governance. Table 3.9 presents OLS regression estimates for the relationship between CEO departure and Corporate Governance. Table 3.10 presents OLS regression estimates for the relationship between CEO departure with Stock Price Crash risk and Corporate Governance. All models include the following variables to control for Leverage, the

ratio of total liabilities to total assets; Market to Book, the ratio of market value to book value of equity; Return on Equity, the ratio of income before extraordinary items to equity; Size, the natural logarithm of total assets at fiscal year-end; and Firm Age, the number of years that the firm is covered in the Compustat universe; HHI, the sum of the square market share of all the firms in an industry, where a value close to zero is an indicator of a highly competitive environment; Capital Expenditure; Capital expenditure divided by total assets, adjusted for the median value of the industry's capital expenditure. Industry definition follows the 48-industry classification suggested by Fama&French; Earnings, the operating income before depreciation, advertising and R&D divided by beginning of the year sales revenue in year; Cash Flows, operating income before depreciation divided by beginning of the year net assets and Litigation, an indicator variable set equal to one when the firm is in the biotechnology (four-digit SIC codes 2833–2836 and 8731–8734), computer (four-digit SIC codes 3570–3577 and 7370–7374), electronics (four-digit SIC codes 3600–3674), or retail (four-digit SIC codes 5200–5961) industries, and zero otherwise [following Francis, Philbrick and Schipper (1994)]. The regression models include year and industry dummies to control time-invariant fixed year and industry-specific effects. All models include a constant and the standard errors are clustered at the firm-year level. All continuous variables are z-score standardized to have a mean value of zero and variance of one to put all variables on a common scale.

Results presented in Table 3.8 indicate that crash firms display an improvement in some of the corporate governance mechanisms prior to the stock price crash. More specifically, there is a statistically significant (p-value<0.01) increase in the percentage of independent directors and the percentage of female directors before and during the stock price crash. After the crash, firms retain the increased percentage of independent directors and tend to reduce the percentage of busy directors in the board. Finally, firms that have experienced a stock price crash tend to attract more transient institutional investors, after the crash. This was expected, since such category of investors tends to demonstrate preference on short-term outcomes, which is compatible with the managerial short-termism in firms that have experienced a stock price crash.

**[Insert Table 3.8, here]**

However, in the case of CEO departure (Table 3.9), the increase of the percentage of independent directors, as well as the increase of the percentage of independent directors which are also members of the audit committee, happens ex post. There is also an increase in the percentage of female directors both before and after CEO departure. Before CEO departure,

firms attract both dedicated and transient institutional investors. Finally, after CEO departure there is an increase of the percentage of directors that are also members of other Major Company Boards. Prior research states that firms that choose to appoint busy directors possibly need specific director expertise more than director time (Field, Lowry, and Mkrtchyan, 2013). This is an indication that after CEO departure firms value the importance of advising, even though busy directors could be less effective at their monitoring role.

**[Insert Table 3.9, here]**

Table 3.10 presents the relationship between CEO departure with Stock Price Crash and Corporate Governance. The combination of the results presented in the two previous tables enable the isolation of the effect of crash and CEO departure. Analysis presented in Table 3.10 allows the investigation of how firms react, in terms of their corporate governance, to the important events of stock price crashes and CEO departures. Before CEO Departure with Crash there is an increase in the percentage of female directors and firms tend to attract transient institutional investors. However, Before CEO Departure without Crash, even if there is a higher percentage of female directors, there are fewer independent directors and more busy directors in the board. This can be considered as the ideal environment for the manifestation of the CEOs short-termism behavior, which is mainly characterized by the absence of appropriate monitoring. During CEO Departure with Crash, firms tend to increase the number of independent directors and maintain it higher After CEO Departure with Crash. Furthermore, firms After CEO Departure with Crash are appeared to increase also the percentage of female directors and the percentage of directors that are simultaneously members of the audit committee. However, the increase in the percentage of busy directors happens only after CEO departure, in firms that have not experienced a stock price crash. This implies that when CEO departure is accompanied with a stock price crash, firm realizes that there is a need to adjust specific corporate governance dimensions that can enhance the monitoring of managerial decisions and limit the CEO's ability to act opportunistically.

**[Insert Table 3.10, here]**

# 5 Conclusion

This study extends the extant literature by relating the occurrence of the firm-specific stock price crashes with the CEO departure. Specifically, it explores the relationship between the CEO departure and firm-specific stock price crashes, after controlling for a large set of firm

and CEO related variables. The results show that the occurrence of a stock price crash is heightened prior to the departure of the CEO. Particularly, one and two years before the CEO departure, firms experience 24.5% and 23.9% more stock price crashes than the rest years of CEO tenure.

To shed more light to the positive relation between the occurrence of stock price crashes and the years prior to CEO departure, the study explores the patterns in CEO's compensation components. It is observed that CEOs in firms that has experienced a CEO departure have a significantly higher number of shares acquired on option exercise and CEOs reduce significantly their options and stock ownership, in comparison with CEOs in their matching firms. This CEO behavior before departure is defined as the "crepuscular behavior". Therefore, it could be concluded that the occurrence of the firm-specific stock price crash is the manifestation of CEO's short-termism behavior.

Finally, the study investigates the environment that enables this behavior to manifest. The results indicate that crash firms display an improvement in their corporate governance mechanisms prior to the stock price crash, which could be responsible for the revelation of hoarded bad news. However, in the case of firms that have experienced CEO departures or CEO departures with stock price crashes, the improvement in corporate governance mechanism happens ex post. This improvement can be considered either as an effort to restore trust, or as an indication of a learning effect. Therefore, it can be concluded that the occurrence of the stock price crash and the CEO departure can be ascribed to the failure of corporate governance to alleviate the agency problems and align the interests between the managers and shareholders. Those harmful, for both the firm and the investors, negative events act as a "shock" for the board to adjust the governance control system and avoid the repetition of such short-termism behavior in the future.

This study contributes to the literature on managerial short-termism by documenting the impact of CEO departure on managerial short-termism. The "crepuscular behavior" of CEOs just before their departure is defined and observed to result in the firm-specific stock price crash occurrence. In line with this short-termism behavior, the study contributes to the literature of agency theory, by identifying a new agency problem that comes out prior to the CEO departure. Additionally, this study is the first so far directly testing the timing of the occurrence of firm-specific stock price crashes and answers to some extent the question of when do stock price crashes occur. Finally, this research adds to the literature of corporate governance. The absence of appropriate monitoring in firms that experience CEO departures with stock price crashes,

creates the ideal environment for the manifestation of CEOs short-termism behavior. However, the evidence that the board improved governance mechanisms, at least ex-post, is empowering and encouraging.

# 6 Appendix-Chapter 3

**Definition of variables**

| Variable | Definition |
|---|---|
| **Panel A:** Dependent variables | |
| CRASH | An indicator variable set equal to one if the firm j has experienced one or more crash weeks during the fiscal year t, and zero otherwise.<br>A week is defined as a "crash week", when the firm-specific weekly returns ($W_{j,w}$) fall at least 3.2 standard deviation below the average firm-specific weekly return in year t. The firm-specific weekly returns are estimated as $W_{j,w} = \ln [1 + e_{j,w}]$, where the $e_{j,w}$ are the residuals from the following equation:<br>$r_{j,w} = a_j + b_{1,j}r_{m,w-2} + b_{2,j}r_{m,w-1} + b_{3,j}r_{m,w} + b_{4,j}r_{m,w+1} + b_{5,j}r_{m,w+2} + b_{6,j}r_{i,w-2} + b_{7,j}r_{i,w-1} + b_{8,j}r_{i,w} + b_{9,j}r_{i,w+1} + b_{10,j}r_{i,w+2} + e_{j,w}$<br>where $r_{j,w}$ is the return on stock j in week w, and $r_{i,w}$ is the Fama and French value-weighted industry index and $r_{m,w}$ is the value-weighted market index in that week. |
| NCSKEW | The negative of the third moment of firm-specific weekly returns ($W_{j,w}$) divided by the standard deviation of firm-specific weekly returns raised to the third power, as in the following equation:<br>$NCSKEWj,t = -[n(n-1)^{\frac{3}{2}} \sum w_{j,t}^3]/[(n-1)(n-2)(\sum w_{j,t}^2)^{\frac{3}{2}}]$. |
| **Panel B:** Main Independent Variables | |
| 3Y Before | An indicator variable set equal to one if we are three fiscal years before the year of CEO departure, and zero otherwise. |
| 2Y Before | An indicator variable set equal to one if we are two fiscal years before the year of CEO departure, and zero otherwise. |
| 1Y Before | An indicator variable set equal to one if we are one fiscal year before the year of CEO departure, and zero otherwise. |
| CEO Departure | An indicator variable set equal to one if there is a CEO departure in firm's CEO, during the fiscal year t, and zero otherwise. |
| 1Y After | An indicator variable set equal to one if we are one fiscal year after the year of CEO departure, and zero otherwise. |
| Before CEO Departure | An indicator variable set equal to one if we are one or two or three fiscal years before the year of CEO departure, and zero otherwise. |
| After CEO Departure | An indicator variable set equal to one if we are one or two or three fiscal years after the year of CEO departure, and zero otherwise. |
| Before Crash | An indicator variable set equal to one if we are one or two or three fiscal years before the Stock Price Crash, and zero otherwise. |
| After Crash | An indicator variable set equal to one if we are one or two or three fiscal years after the Stock Price Crash, and zero otherwise. |
| Before CEO Departure with Crash | An indicator variable set equal to one if we are one fiscal year before the year of CEO departure and the firm has experienced a Stock Price Crash this fiscal year, or if we are two fiscal years before the year of CEO departure and the firm has experienced a Stock Price Crash this fiscal year, or if we are three fiscal years before the year of CEO departure and the firm has experienced a Stock Price Crash this fiscal year, and zero otherwise. |
| Before CEO Departure without Crash | An indicator variable set equal to one if we are one fiscal year before the year of CEO departure and the firm has not experienced a Stock Price Crash this fiscal year, or if we are two fiscal years before the year of CEO departure and the firm has not experienced a Stock Price Crash this fiscal year, or if we are three fiscal years before the year of CEO departure and the firm has not experienced a Stock Price Crash this fiscal year, and zero otherwise. |
| CEO Departure with Crash | An indicator variable set equal to one if there is a CEO departure in firm's CEO, during the fiscal year t and the firm has experienced a Stock Price Crash in any of the current or previous three fiscal years, and zero otherwise. |

| | |
|---|---|
| CEO Departure without Crash | An indicator variable set equal to one if there is a CEO departure in firm's CEO, during the fiscal year t and the firm has not experienced a Stock Price Crash in any of the current or previous three fiscal years, and zero otherwise. |
| After CEO Departure with Crash | An indicator variable set equal to one if we are one fiscal year after the year of CEO departure and the firm has experienced a Stock Price Crash this fiscal year, or if we are two fiscal years after the year of CEO departure and the firm has experienced a Stock Price Crash this fiscal year, or if we are three fiscal years after the year of CEO departure and the firm has experienced a Stock Price Crash this fiscal year, and zero otherwise. |
| After CEO Departure without Crash | An indicator variable set equal to one if we are one fiscal year after the year of CEO departure and the firm has not experienced a Stock Price Crash this fiscal year, or if we are two fiscal years after the year of CEO departure and the firm has not experienced a Stock Price Crash this fiscal year, or if we are three fiscal years after the year of CEO departure and the firm has not experienced a Stock Price Crash this fiscal year, and zero otherwise. |

**Panel C:** Main Control Variables

| | |
|---|---|
| Size | The natural logarithm of total assets at fiscal year-end. |
| Firm Age | The natural logarithm of the number of years that the firm is covered in the Compustat universe. |
| Market to Book | The ratio of market value to book value of equity. |
| Leverage | The ratio of total liabilities to total assets. |
| Return on Equity | The ratio of income before extraordinary items to equity. |
| Stock Return | Average firm-specific weekly returns during the fiscal year. |
| Dturn | The detrended average weekly stock trading volume during the fiscal year. |

**Panel D:** Variables related to firm environment

| | |
|---|---|
| HHI | The sum of the square market share of all the firms in an industry, where the market share refers to the sales of the firm over the total sales of all firms in each industry. |
| Competitiveness | The industry adjusted price-cost margin (PCM). PCM is defined as the ratio of firm operating profit to sales. Firm operating profit is calculated by subtracting from sales the cost of goods sold and the selling, general, and administrative expenses. |
| Peer Information | The measure of peer information (following Shroff, Verdi, and Yost, 2017), is estimated at the 3-digit NAICS industry-year level, as the sum of the Earnings Sync quintile rank, the %Public quintile rank, and the #Analysts quintile rank, and scaled to be between zero and one. |

**Panel E:** Variables related to quality of earnings

Conservatism

The firm-year-specific coefficient $b_{3jt}$ from the following equation proxies for conditional conservatism:

$$X_{j,t}=a_o+b_{1t}D_{j,t}+b_{2j,t}R_{j,t}+b_{3j,t}D_{j,t}x\ R_{j,t}+e_{j,t}$$

where X is the income before extraordinary items (ib) divided by lagged market value (MV) as defined previously, D is an indicator variable set equal to 1 if the return is negative and zero otherwise, R is the compound return over the 12-month period ending at the fiscal year-end. Then, the firm-year-specific coefficient $b_{3jt}$ which proxies for conditional conservatism, is expressed as a linear function of firm-year-specific characteristics that is correlated with the timeliness of conservatism news:

$$Conservatism= b_{3j,t}= n_{0t}+n_{1t}MV_{j,t}+n_{2t}MTB_{j,t}+n_{3t}DTE_{j,t}$$

where MV is the natural logarithm of the market value, MTB is the market to book ratio, ie the MV divided by total common/ordinary equity (ceq), DTE is the debt to equity ratio, ie the sum of debt in current liabilities (dlc) and long term debt (dltt) over the MV. The estimated coefficients $n_{0t}$, $n_{1t}$, $n_{2t}$, and $n_{3t}$ that are needed for the conservatism proxy are derived from the last equation which is estimated using five-year rolling regressions.

| | |
|---|---|
| Opacity | Following Hutton, Marcus, and Tehranian (2009), opacity is measured as the prior three years' moving sum of the absolute value of discretionary accruals (*DACC*), where *DACC* is measured as follows:<br>$DACC_t = \frac{TA_t}{ASSETS_{t-1}} - (\widehat{a_0}\frac{1}{ASSETS_{t-1}} + \widehat{b_1}\frac{\Delta SALES_t - \Delta RECEIVABLES_t}{ASSETS_{t-1}} + \widehat{b_2}\frac{PPE_t}{ASSETS_{t-1}})$<br>where Total accruals (TA) are estimated as income before extraordinary items, minus cash flow from operating activities adjusted for extraordinary items and discontinued operations and regressed on the following cross-sectional regression equation using the firms in each Fama and French 48 industries for each fiscal year:<br>$\frac{TA_t}{ASSETS_{t-1}} = a_o\frac{1}{ASSETS_{t-1}} + b_1\frac{\Delta SALES_t}{ASSETS_{t-1}} + b_2\frac{PPE_t}{ASSETS_{t-1}} + e_t$<br>where TA denotes total accruals, ASSETS denotes total assets, ΔSALES denotes change in sales, ΔRECEIVABLES denotes change in receivables and PPE denotes property, plant, and equipment. |
| **Panel F:** Variables related to 10K filings | |
| Negative Tone | The percentage of words in the 10K with negative tone [following the Loughran and McDonald(2011) dictionary]. |
| Positive Tone | The percentage of words in the 10K with positive tone [following the Loughran and McDonald(2011) dictionary]. |
| 10K N_Words | The natural logarithm of the number of words in the 10K filings. |
| 10K Size | The natural logarithm of the gross 10K filing size. |
| 10K Readability | Following Li (2008), 10K report readability is measured using the following formula for the Readability of 10K Filings Index:<br>*Readability of 10K Filing Index =*<br>*(words per sentence + percentage of complex words) × 0.4*<br>where complex words are defined as words with three or more syllables. |
| **Panel G:** Other firm-level variables | |
| Financial Constraints | This measure is derived from the model of Hadlock and Pierce (2010), which is defined by the following equation:<br>$Financial\ Constraints = -0.737 \times Size + 0.043 \times Size^2 - 0.040 \times Firm\ Age$<br>where S*ize* is the natural logarithm of the book value of total assets, and Firm Age as it has already been defined. |
| Z-score | The Z-Score is computed as the fitted value using the original or either the coefficients of the following models proposed by Altman (1968):<br>$Z\ score\ (original) = 1.2\frac{WC}{Assets} + 1.4\frac{RE}{Assets} + 3.3\frac{EBIT}{Assets} + 0.6\frac{V}{TL} + 0.999\frac{S}{Assets}$<br>where WC/Assets is working capital divided by total assets, RE/ Assets is retained earnings divided by total assets, EBIT/ Assets is earnings before interest and taxes divided by total assets, V/TL is market value of equity divided by total liabilities, and S/Assets is sales divided by total assets. |
| Capital Expenditure | Capital expenditure divided by total assets, adjusted for the median value of the industry's capital expenditure. Industry definition follows the 48-industry classification suggested by Fama&French. |
| Earnings | The operating income before depreciation, advertising and R&D divided by beginning of the year sales revenue in year. |
| Cash Flows | Operating income before depreciation divided by beginning of the year net assets. |
| Litigation | An indicator variable set equal to 1 when the firm is in the biotechnology (4-digit SIC codes 2833–2836 and 8731–8734), computer (4-digit SIC codes 3570–3577 and 7370–7374), electronics (4-digit SIC codes 3600–3674), or retail (4-digit SIC codes 5200–5961) industries, and zero otherwise (following Francis, Philbrick, and Schipper, 1994). |

| **Panel H:** Variables related to CEO characteristics | |
|---|---|
| CEO Age | The age of the CEO. |
| CEO Tenure | The number of years in a CEO position with a particular company. |
| Short CEO Tenure | An indicator variable set equal to one if the CEO has tenure less than three years, and zero otherwise. |
| Long CEO Tenure | An indicator variable set equal to one if the CEO has tenure more than eight years, and zero otherwise. |
| Female CEO | An indicator variable set equal to one if the CEO is female, and zero otherwise. |
| Managerial Ability | Managerial ability proposed by Demerjian, Lev, and McVay (2012), based on managers' efficiency in generating revenues while using either the same or even fewer resources than their peers in the same industry. |
| Dual CEO | An indicator variable set equal to one if the CEO is also the chairman of the firm, and zero otherwise. |

| **Panel I:** Variables related to CEO compensation | |
|---|---|
| CEO Stock Incentives | The CEO stock holdings incentives ratio estimated as in Bergstresser and Philippon (2006). |
| CEO Option Incentives | The CEO option holdings incentives ratio estimated as in Bergstresser and Philippon (2006). |
| CEO Ownership | The sum of the number of shares owned (options excluded), the unexercised exercisable options, the unexercised unexercisable options and the restricted stock holdings over the total number of firm's common shares outstanding. |
| Bonus to Salary | The ratio of CEO's bonus to salary. |
| Total Compensation | Total compensation for the individual year, comprised of the following: Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Total Value of Stock Options Granted (using Black-Scholes), Long-Term Incentive Payouts, and All Other Total. |
| Bonus | The dollar value of a bonus (cash and non-cash) earned by the CEO during the fiscal year. |
| Salary | The dollar value of the base salary (cash and non-cash) earned by the CEO during the fiscal year. |
| Options | The intrinsic value of the vested and unvested in-the-money options held by CEO. |
| Shares Unrestricted Excluding Options | Number of shares held by the CEO, excluding options and restricted stock holdings. |
| Shares | Total shares owned by the CEO. |
| Shares Excluding Options | Number of shares held by the CEO, excluding options. |
| Shares from Option Exercise | Number of Shares Acquired on Option Exercise. |

| **Panel J:** Variables related to CEO turnover | |
|---|---|
| Retirement | An indicator variable set equal to one when (1) the turnover is due to retirement, as identified in Execucomp, and (2) the turnover occurs at greater than 59 years of age, and zero otherwise. When CEOs are below age 60, even if the reported reason in Execucomp is retirement, are more likely to depart the firm due to a forced turnover. Age 60 is also used as a cutoff for determining forced versus natural turnover in Parrino (1997) and Jenter and Kanaan (2010). |
| Forced Turnover | A turnover is considered as Forced if (1) the turnover is not due to death, as identified in Execucomp, (2) the turnover occurs at less than 60 years of age, and (3) the CEO is not |

| | |
|---|---|
| | subsequently reported in Execucomp as the CEO of another firm (following Fisman, Khurana, Rhodes-Kropf, and Yim, 2014) |
| **Panel K:** Variables related to corporate governance | |
| Independent Directors | Number of independent directors divided by the board size. |
| Female Directors | Number of female directors divided by the board size. |
| Busy directors | Number of directors who are also members of other Major Company Boards divided by the board size. |
| Audit members | Number of independent directors which are also members of the audit committee divided by the board size. |
| Dedicated Inst Investors | The percentage of stock ownership in the firm by dedicated institutional investors [following the classifications as in Bushee (1998, 2001)]. |
| Transient Inst Investors | The percentage of stock ownership in the firm by transient institutional investors [following the classifications as in Bushee (1998, 2001)]. |

# 7 Figures-Chapter 3

**Figure 3. 1. Evolution of stock price crashes surrounding CEO Departures**

This figure displays the percentage of stock price crashes surrounding CEO Departures, from six years prior to CEO Departure (6Y Before) to one year after CEO Departure (1Y After). There are 248 CEO Departures that are due to retirements, at the year of CEO Departure. The straight line represents the frequency of stock price crashes for 17,902 firm-year observations for the period 1994-2016.

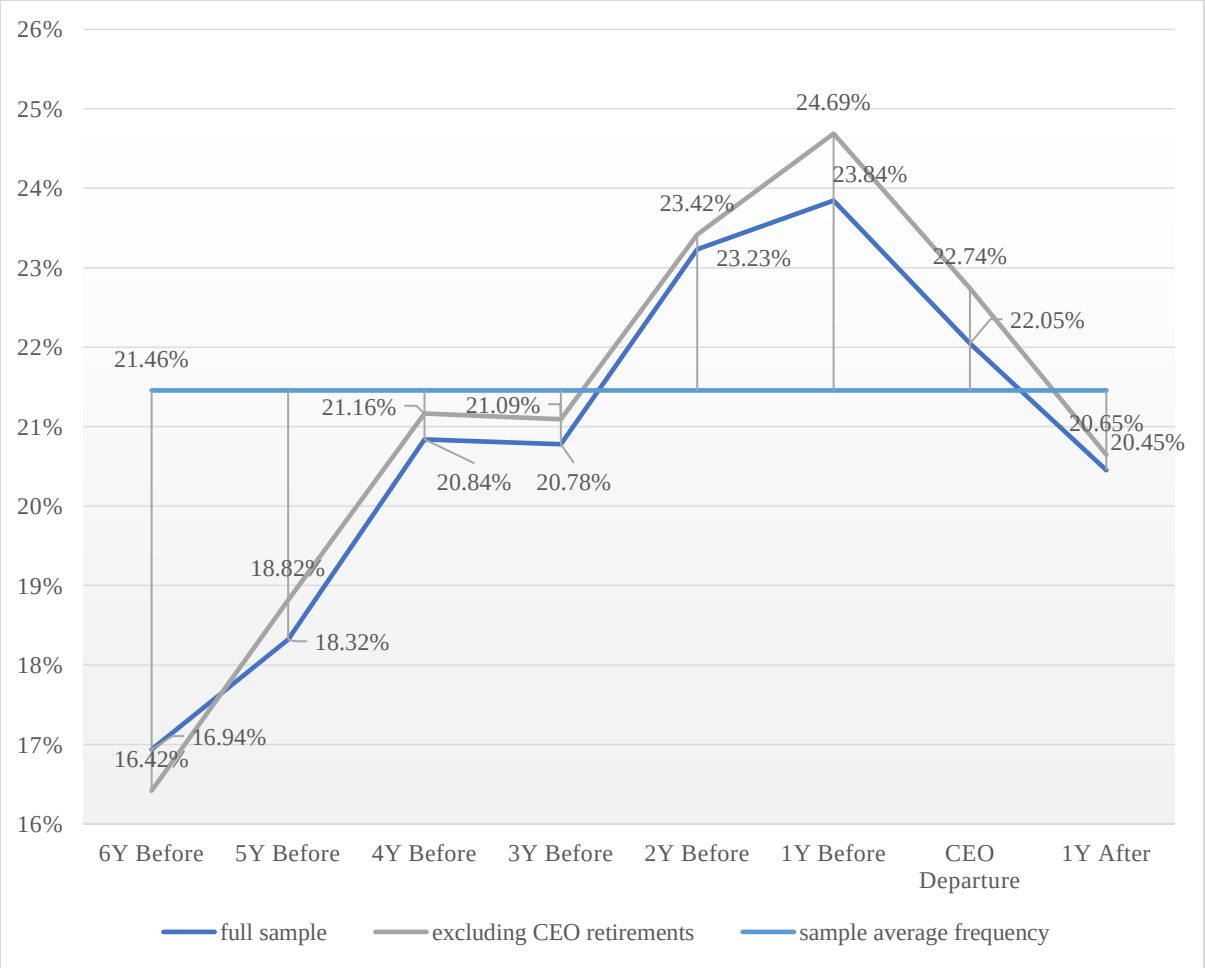
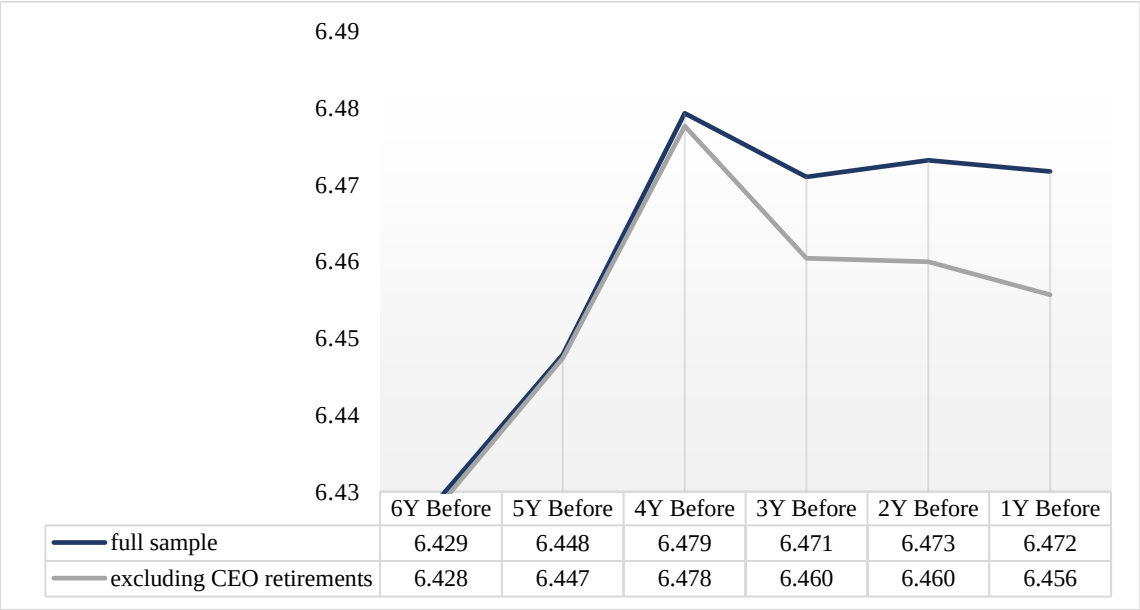


**Figure 3. 2. Evolution of executive compensation before CEO Departures**

This figure displays the average value for different executive compensation components (mentioned in the title), from six years prior to the CEO Departure (6Y Before) to one year prior to the CEO Departure (1Y After) for the full sample (17,902 observations) and the sample after excluding 248 CEO Departures due to retirements. The time period is 1994-2016.

**Figure 3. 2a.** Salary

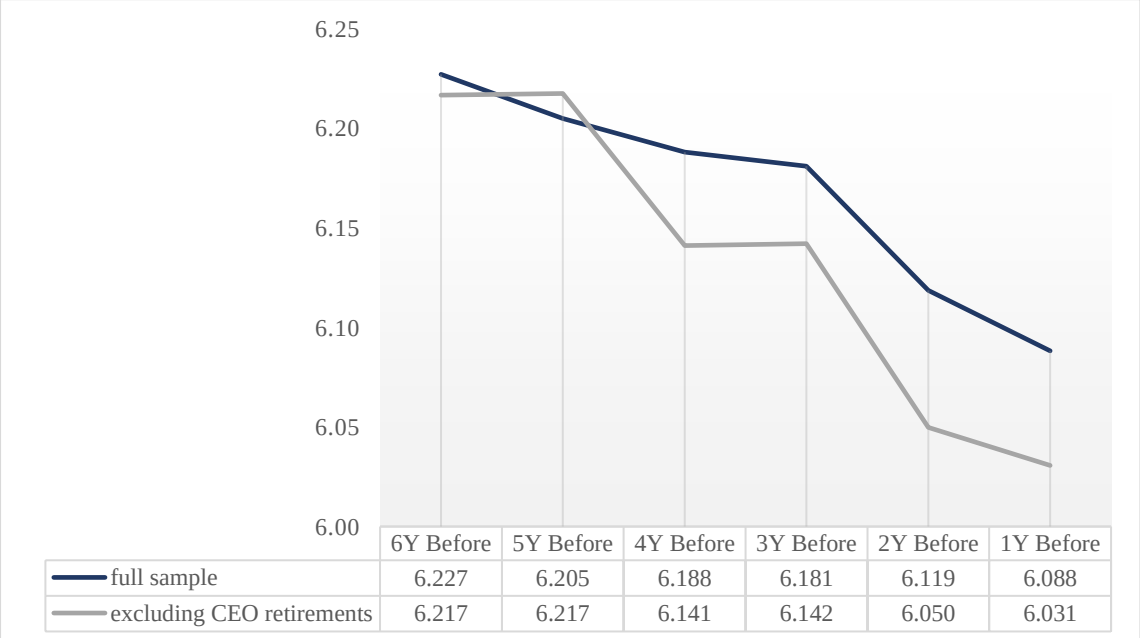
The natural logarithm of the dollar value of the base salary (cash and non-cash) earned by the CEO during the fiscal year.




| | 6Y Before | 5Y Before | 4Y Before | 3Y Before | 2Y Before | 1Y Before |
|---|---|---|---|---|---|---|
| full sample | 6.429 | 6.448 | 6.479 | 6.471 | 6.473 | 6.472 |
| excluding CEO retirements | 6.428 | 6.447 | 6.478 | 6.460 | 6.460 | 6.456 |

**Figure 3. 2b.** Bonus

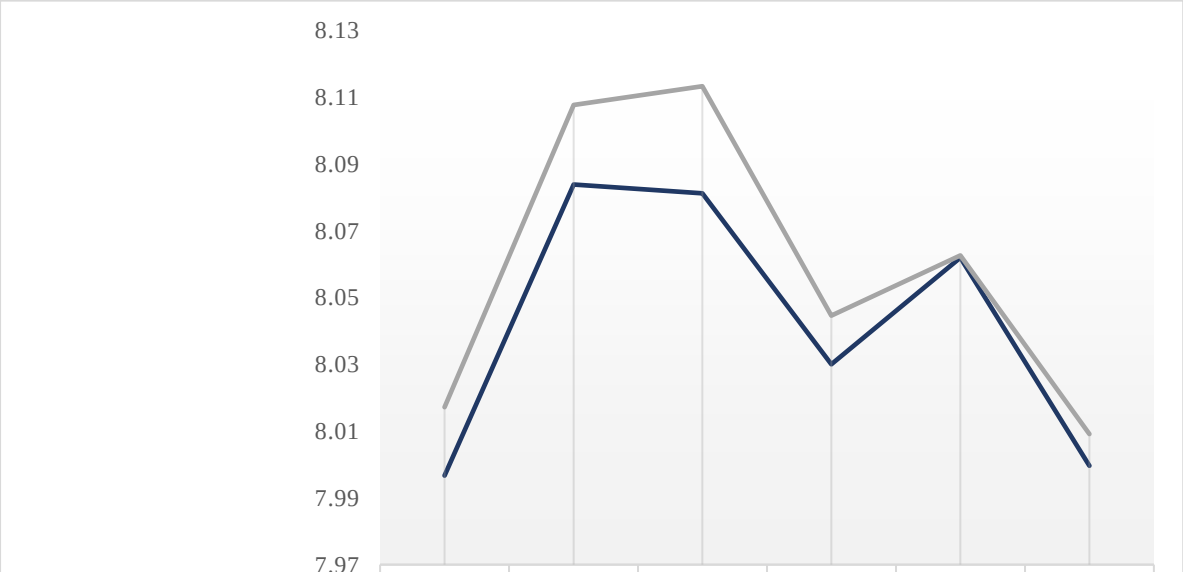
The natural logarithm of the dollar value of a bonus (cash and non-cash) earned by the CEO during the fiscal year.




| | 6Y Before | 5Y Before | 4Y Before | 3Y Before | 2Y Before | 1Y Before |
|---|---|---|---|---|---|---|
| full sample | 6.227 | 6.205 | 6.188 | 6.181 | 6.119 | 6.088 |
| excluding CEO retirements | 6.217 | 6.217 | 6.141 | 6.142 | 6.050 | 6.031 |

**Figure 3. 2c.** Total Compensation

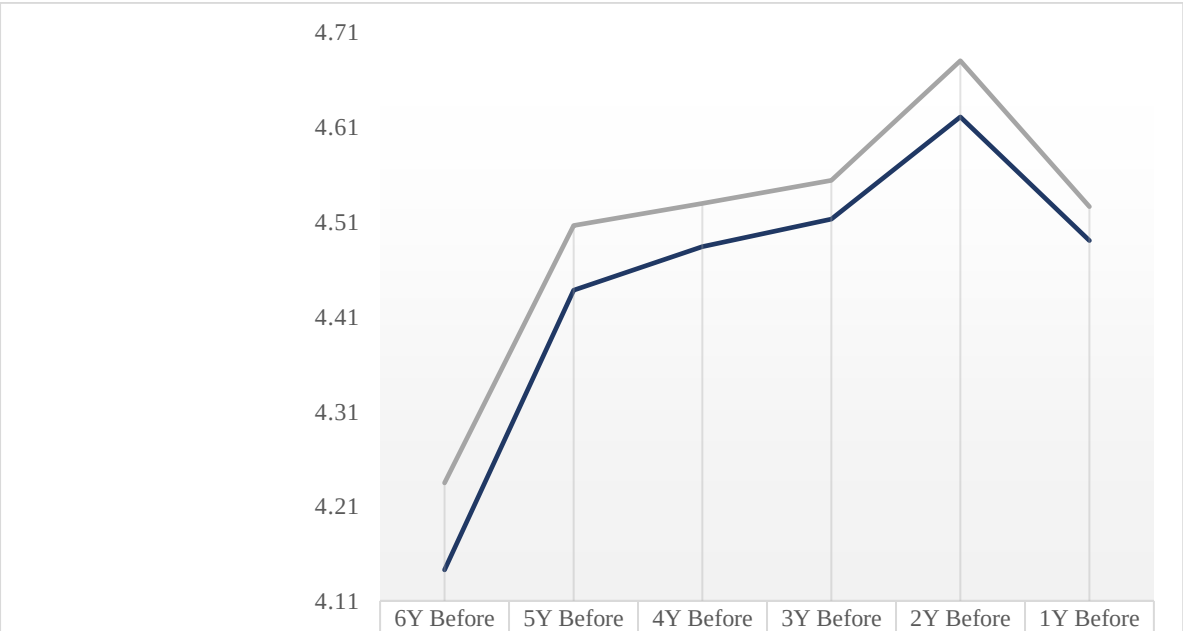
The natural logarithm of the total compensation for the individual year, comprised of the following: Salary, Bonus, Other Annual, Total Value of Restricted Stock Granted, Total Value of Stock Options Granted (using Black-Scholes), Long-Term Incentive Payouts, and All Other Total.




| | 6Y Before | 5Y Before | 4Y Before | 3Y Before | 2Y Before | 1Y Before |
|---|---|---|---|---|---|---|
| full sample | 7.997 | 8.084 | 8.081 | 8.030 | 8.062 | 8.000 |
| excluding CEO retirements | 8.017 | 8.108 | 8.113 | 8.045 | 8.063 | 8.009 |

**Figure 3. 2d.** Shares from Option Exercise

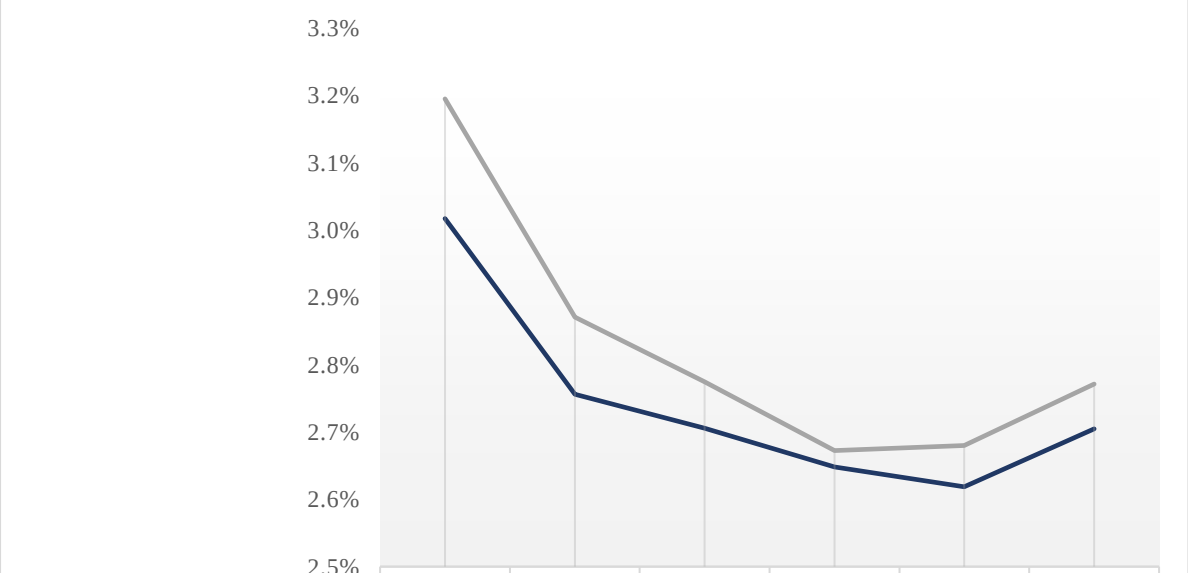
The natural logarithm of the number of Shares Acquired on Option Exercise.




| | 6Y Before | 5Y Before | 4Y Before | 3Y Before | 2Y Before | 1Y Before |
|---|---|---|---|---|---|---|
| full sample | 4.143 | 4.438 | 4.484 | 4.513 | 4.621 | 4.490 |
| excluding CEO retirements | 4.234 | 4.506 | 4.530 | 4.554 | 4.680 | 4.526 |

**Figure 3. 2e.** CEO Ownership

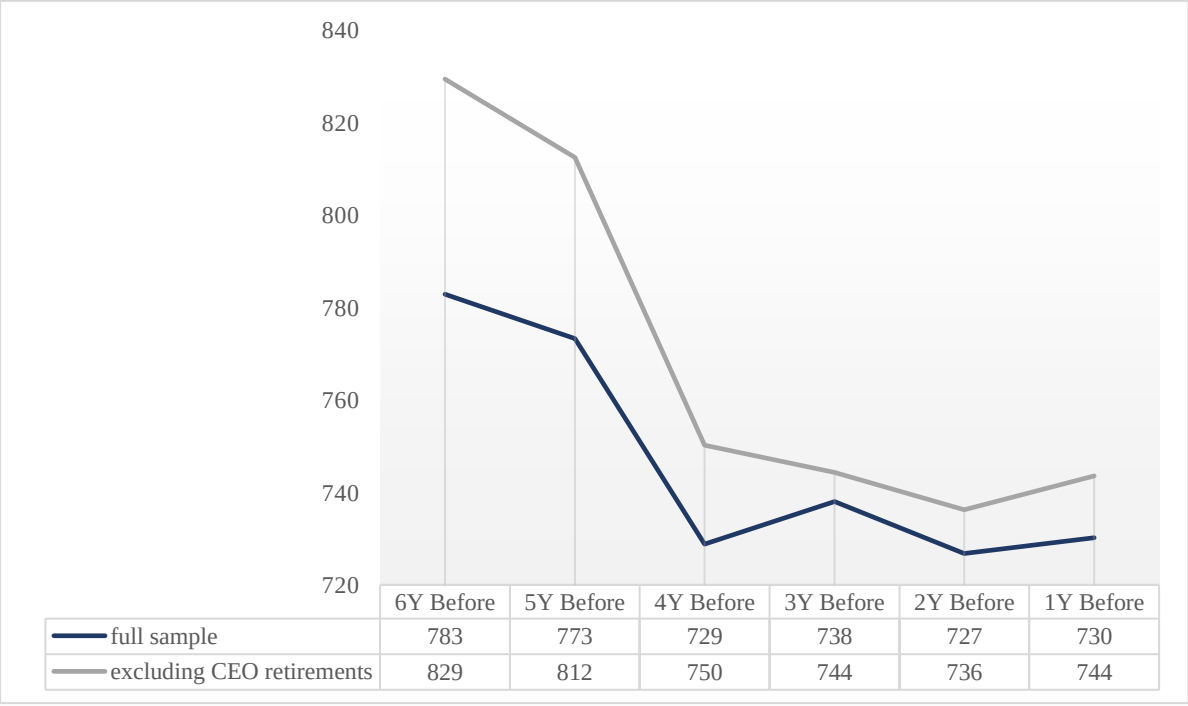
The sum of the number of shares owned (options excluded), the unexercised exercisable options, the unexercised unexercisable options and the restricted stock holdings over the total number of firm's common shares outstanding.




| | 6Y Before | 5Y Before | 4Y Before | 3Y Before | 2Y Before | 1Y Before |
|---|---|---|---|---|---|---|
| full sample | 3.02% | 2.76% | 2.71% | 2.65% | 2.62% | 2.70% |
| excluding CEO retirements | 3.19% | 2.87% | 2.77% | 2.67% | 2.68% | 2.77% |

**Figure 3. 2f.** Options

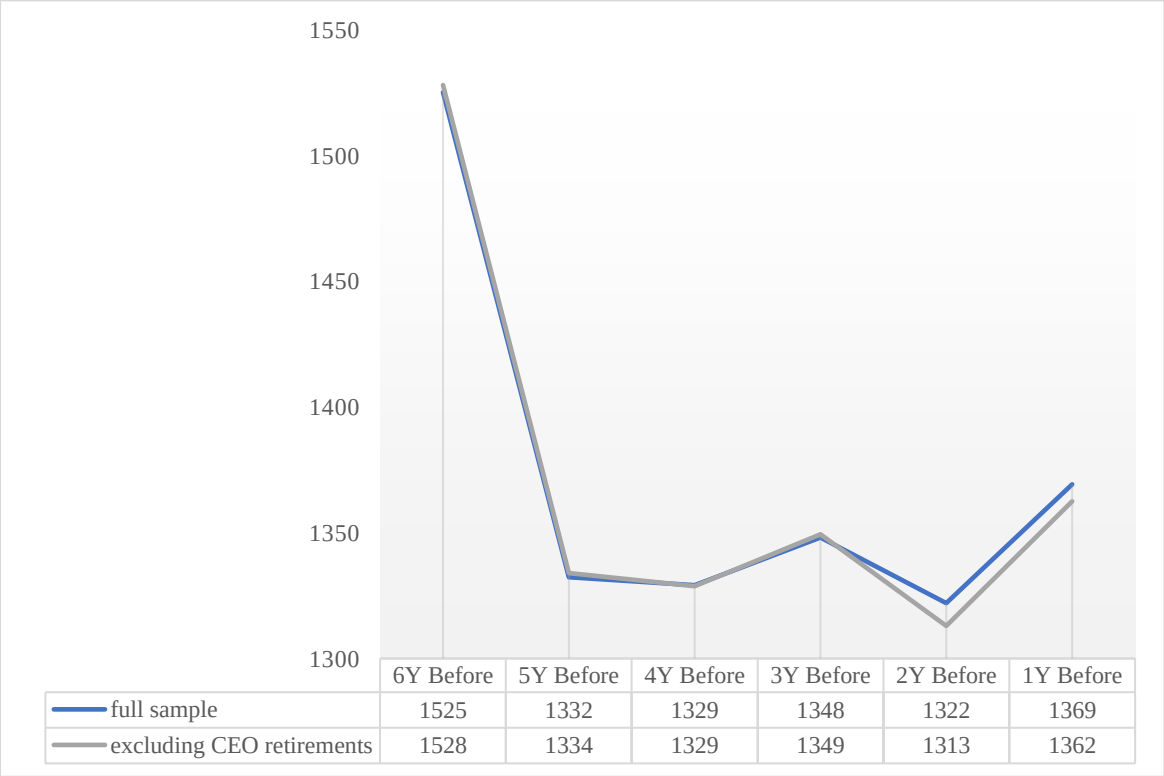
The intrinsic value of the vested and unvested in-the-money options held by the CEO.




| | 6Y Before | 5Y Before | 4Y Before | 3Y Before | 2Y Before | 1Y Before |
|---|---|---|---|---|---|---|
| full sample | 783 | 773 | 729 | 738 | 727 | 730 |
| excluding CEO retirements | 829 | 812 | 750 | 744 | 736 | 744 |

**Figure 3. 2g**. Shares

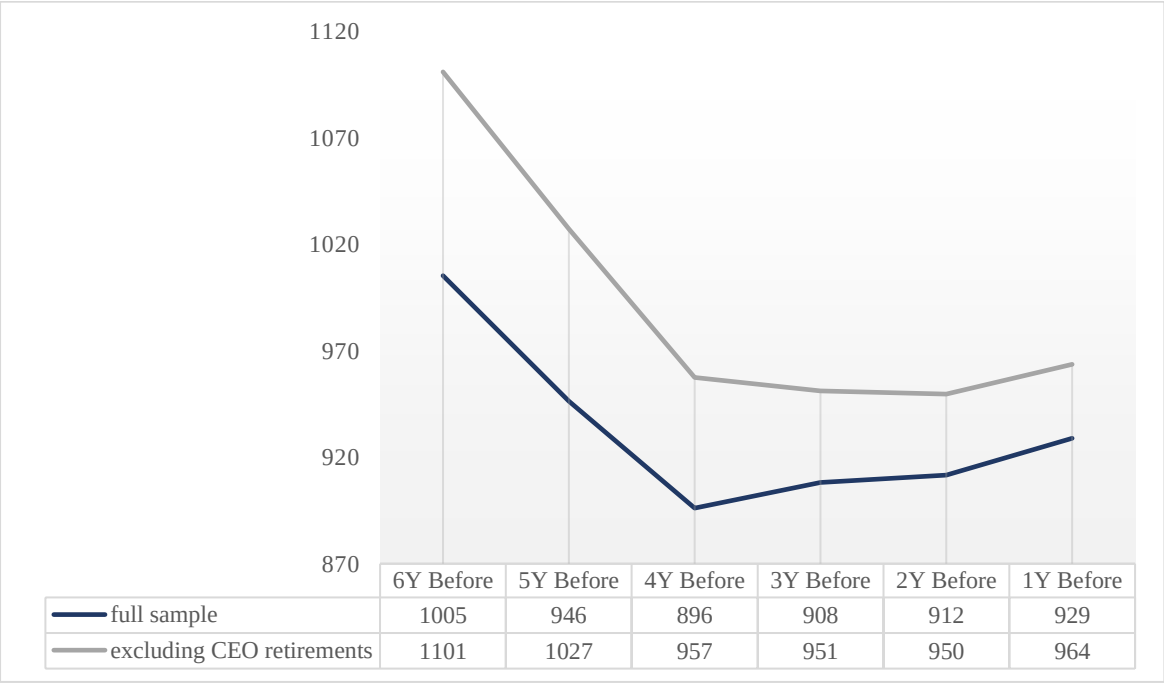
Total shares owned by the CEO.




| | 6Y Before | 5Y Before | 4Y Before | 3Y Before | 2Y Before | 1Y Before |
|---|---|---|---|---|---|---|
| full sample | 1525 | 1332 | 1329 | 1348 | 1322 | 1369 |
| excluding CEO retirements | 1528 | 1334 | 1329 | 1349 | 1313 | 1362 |

**Figure 3. 2h.** Shares Excluding Options

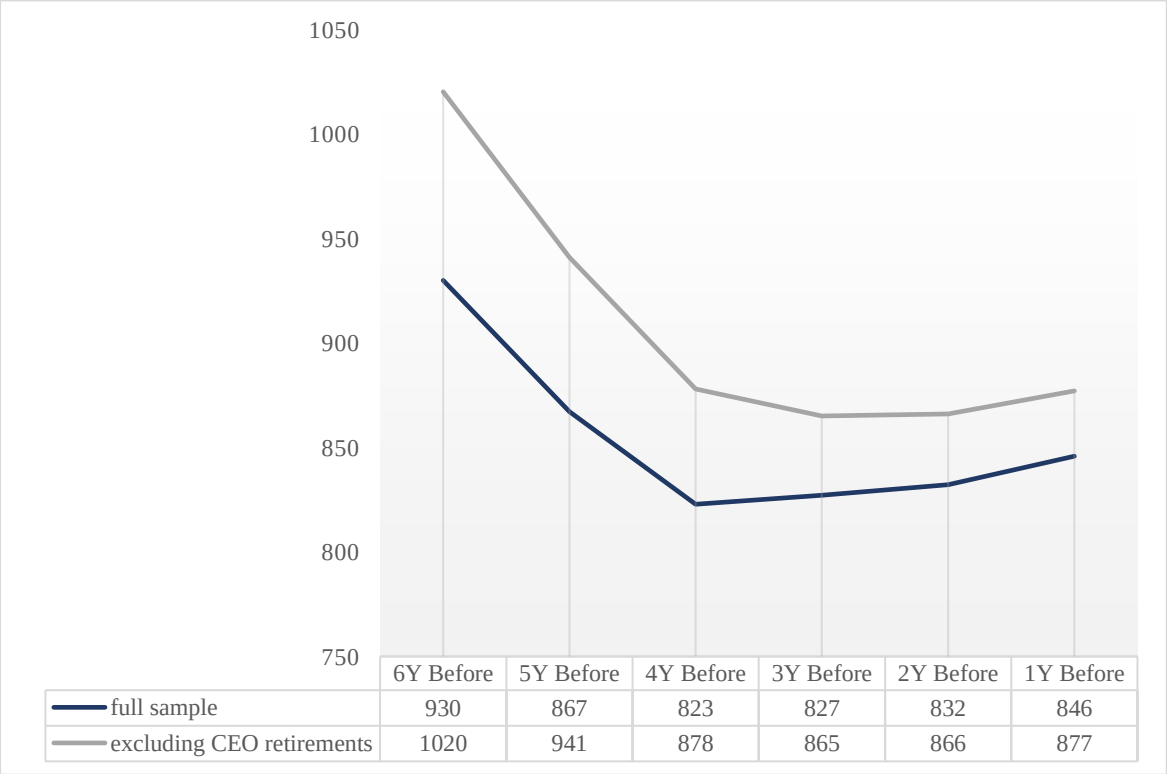
Number of shares held by the CEO, excluding options.




| | 6Y Before | 5Y Before | 4Y Before | 3Y Before | 2Y Before | 1Y Before |
|---|---|---|---|---|---|---|
| full sample | 1005 | 946 | 896 | 908 | 912 | 929 |
| excluding CEO retirements | 1101 | 1027 | 957 | 951 | 950 | 964 |

**Figure 3. 2i.** Unrestricted Shares Excluding Options

Number of shares held by the CEO, excluding options and restricted stock holdings.




| | 6Y Before | 5Y Before | 4Y Before | 3Y Before | 2Y Before | 1Y Before |
|---|---|---|---|---|---|---|
| full sample | 930 | 867 | 823 | 827 | 832 | 846 |
| excluding CEO retirements | 1020 | 941 | 878 | 865 | 866 | 877 |

# 8 Tables-Chapter 3

**Table 3. 1. Annual statistics of Stock price crashes and CEO Departures**

The sample consists of 17,902 firm-year observations covering the period 1994-2016.

| Year | Number of observations | Number of stock price crashes | Percentage of stock price crashes | Average returns during crashes | Number of CEO Departures | Percentage of CEO Departures |
|---|---|---|---|---|---|---|
| **1994** | 361 | 52 | 14.40% | -15.39% | 36 | 9.97% |
| **1995** | 504 | 74 | 14.68% | -16.35% | 50 | 9.92% |
| **1996** | 588 | 88 | 14.97% | -18.21% | 55 | 9.35% |
| **1997** | 693 | 126 | 18.18% | -21.34% | 72 | 10.39% |
| **1998** | 746 | 132 | 17.69% | -25.63% | 81 | 10.86% |
| **1999** | 736 | 151 | 20.52% | -27.96% | 95 | 12.91% |
| **2000** | 745 | 133 | 17.85% | -24.26% | 82 | 11.01% |
| **2001** | 815 | 174 | 21.35% | -23.36% | 70 | 8.59% |
| **2002** | 817 | 143 | 17.50% | -17.76% | 78 | 9.55% |
| **2003** | 944 | 202 | 21.40% | -17.35% | 80 | 8.47% |
| **2004** | 921 | 223 | 24.21% | -15.36% | 104 | 11.29% |
| **2005** | 876 | 205 | 23.40% | -14.59% | 80 | 9.13% |
| **2006** | 899 | 180 | 20.02% | -16.03% | 83 | 9.23% |
| **2007** | 986 | 225 | 22.82% | -22.91% | 107 | 10.85% |
| **2008** | 984 | 176 | 17.89% | -20.58% | 89 | 9.04% |
| **2009** | 915 | 173 | 18.91% | -14.84% | 64 | 6.99% |
| **2010** | 900 | 172 | 19.11% | -15.15% | 74 | 8.22% |
| **2011** | 865 | 206 | 23.82% | -14.35% | 94 | 10.87% |
| **2012** | 817 | 227 | 27.78% | -14.06% | 74 | 9.06% |
| **2013** | 793 | 202 | 25.47% | -15.03% | 82 | 10.34% |
| **2014** | 732 | 192 | 26.23% | -15.18% | 82 | 11.20% |
| **2015** | 682 | 199 | 29.18% | -16.22% | 77 | 11.29% |
| **2016** | 583 | 186 | 31.90% | -14.75% | 60 | 10.29% |
| **Averages** | 778.348 | 167 | 21.27% | -18.12% | 76.913 | 9.95% |
| **Totals** | **17,902** | **3,841** | | | **1,769** | |

**Table 3. 2. Summary statistics**

This table presents summary statistics for the variables used in the study for the period 1994-2016. The crash risk measures (CRASH, NCSKEW) feature measurements in fiscal year $t + 1$, whereas all the other variables feature measurements in fiscal year $t$. The sample combines data from Compustat with data from CRSP, Execucomp, Institutional Shareholder Services (ISS), and 10K filings. The sample contains 1,891 firms, with 17,902 firm-year observations. Definitions of all the variables are provided in Appendix.

| Variable | Mean | Std | Q1 | Median | Q3 |
|---|---|---|---|---|---|
| **Panel A:** Dependent variables | | | | | |
| **CRASH** | 0.215 | 0.411 | 0.000 | 0.000 | 0.000 |
| **NCSKEW** | 0.108 | 0.796 | -0.361 | 0.053 | 0.494 |
| **Panel B:** Main Independent Variables | | | | | |
| **3Y Before** | 0.073 | 0.260 | 0.000 | 0.000 | 0.000 |
| **2Y Before** | 0.085 | 0.279 | 0.000 | 0.000 | 0.000 |
| **1Y Before** | 0.098 | 0.297 | 0.000 | 0.000 | 0.000 |
| **CEO Departure** | 0.099 | 0.298 | 0.000 | 0.000 | 0.000 |
| **1Y After** | 0.102 | 0.302 | 0.000 | 0.000 | 0.000 |
| **Panel C:** Main Control Variables | | | | | |
| **Size** | 7.300 | 1.547 | 6.166 | 7.159 | 8.317 |
| **Firm Age** | 2.922 | 0.731 | 2.398 | 3.045 | 3.555 |
| **Market to Book** | 3.352 | 3.348 | 1.573 | 2.395 | 3.796 |
| **Leverage** | 0.288 | 0.229 | 0.067 | 0.284 | 0.439 |
| **Return on Equity** | 0.096 | 0.265 | 0.046 | 0.116 | 0.187 |
| **Stock Return** | -0.131 | 0.144 | -0.159 | -0.081 | -0.043 |
| **Dturn** | 0.983 | 18.862 | -6.032 | 0.510 | 7.567 |
| **NCSKEW** | 0.102 | 0.776 | -0.361 | 0.049 | 0.481 |
| **Panel D:** Variables related to firm environment | | | | | |
| **HHI** | 0.065 | 0.056 | 0.036 | 0.051 | 0.076 |
| **Competitiveness** | 0.040 | 0.185 | -0.015 | 0.033 | 0.099 |
| **Peer Information** | 0.514 | 0.190 | 0.417 | 0.500 | 0.667 |
| **Panel E:** Variables related to quality of earnings | | | | | |
| **Conservatism** | 0.059 | 0.128 | -0.017 | 0.060 | 0.130 |
| **Opacity** | 0.741 | 1.386 | 0.146 | 0.297 | 0.693 |
| **Panel F:** Variables related to 10K filings | | | | | |
| **Negative Tone** | 0.016 | 0.004 | 0.013 | 0.016 | 0.018 |
| **Positive Tone** | 0.007 | 0.002 | 0.006 | 0.007 | 0.008 |
| **10K N Words** | 10.583 | 0.590 | 10.226 | 10.590 | 10.950 |
| **10K Size** | 14.299 | 1.565 | 12.981 | 14.113 | 15.430 |
| **10K Readability** | 19.946 | 1.270 | 19.188 | 19.829 | 20.532 |
| **Panel G:** Other firm-level variables | | | | | |
| **Financial Constraints** | -3.915 | 0.627 | -4.438 | -3.836 | -3.408 |
| **Z-Score** | 4.925 | 4.390 | 2.510 | 3.744 | 5.707 |
| **Panel H:** Variables related to CEO characteristics | | | | | |
| **CEO Age** | 55.443 | 7.148 | 51.000 | 55.000 | 60.000 |
| **CEO Tenure** | 7.700 | 6.871 | 2.762 | 5.670 | 10.327 |
| **Female CEO** | 0.025 | 0.157 | 0.000 | 0.000 | 0.000 |
| **Managerial Ability** | 0.014 | 0.140 | -0.074 | -0.022 | 0.059 |
| **Dual CEO** | 0.536 | 0.499 | 0.000 | 1.000 | 1.000 |
| **Panel I:** Variables related to CEO compensation | | | | | |
| **CEO Stock Incentives** | 0.147 | 0.187 | 0.030 | 0.077 | 0.181 |
| **CEO Option Incentives** | 0.182 | 0.162 | 0.063 | 0.133 | 0.254 |
| **CEO Ownership** | 0.031 | 0.044 | 0.008 | 0.017 | 0.033 |
| **Bonus to Salary** | 0.522 | 0.790 | 0.000 | 0.006 | 0.855 |
| **Panel J:** Variables related to CEO turnover | | | | | |
| **Retirement** | 0.014 | 0.118 | 0.000 | 0.000 | 0.000 |
| **Forced Turnover** | 0.038 | 0.191 | 0.000 | 0.000 | 0.000 |

**Table 3. 3.** Relationship between CEO Departures and Stock price crashes

This table presents regression estimates for the relationship between CEO Departures and one-year ahead stock price crashes. Models (1) and (2) report logistic regression results for CRASH, while models (3) and (4) report OLS regression results for NCSKEW. The dependent variables are measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. The definitions of all the variables are detailed in Appendix. The estimates include year and industry dummies to control time-invariant fixed year and industry-specific effects. All models include a constant and the standard errors are clustered at the firm-year level. Standard errors are provided in parentheses. All continuous variables are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **CRASH** | | **NCSKEW** | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| 3Y Before | 1.063 | 1.076 | 0.071** | 0.072** |
| | (0.074) | (0.074) | (0.029) | (0.029) |
| 2Y Before | 1.201*** | 1.219*** | 0.098*** | 0.103*** |
| | (0.066) | (0.067) | (0.028) | (0.028) |
| 1Y Before | 1.202*** | 1.223*** | 0.125*** | 0.133*** |
| | (0.062) | (0.062) | (0.026) | (0.026) |
| CEO Departure | 1.046 | 1.072 | 0.065** | 0.081*** |
| | (0.063) | (0.063) | (0.026) | (0.026) |
| 1Y After | 0.928 | 0.952 | -0.040 | -0.027 |
| | (0.063) | (0.063) | (0.025) | (0.025) |
| Size | | 0.968 | | 0.010 |
| | | (0.023) | | (0.009) |
| Firm Age | | 0.918*** | | -0.036*** |
| | | (0.021) | | (0.009) |
| Market to Book | | 1.017 | | 0.027*** |
| | | (0.021) | | (0.008) |
| Leverage | | 0.976 | | -0.028*** |
| | | (0.022) | | (0.009) |
| Return on Equity | | 1.044* | | 0.041*** |
| | | (0.023) | | (0.008) |
| Stock Return | | 1.075*** | | 0.025*** |
| | | (0.026) | | (0.010) |
| Dturn | | 1.033* | | 0.023*** |
| | | (0.020) | | (0.008) |
| NCSKEW | | 1.05*** | | 0.009 |
| | | (0.019) | | (0.008) |
| -2 Log L. / $R^2$ adj. | 18,157 | 18,111 | 0.015 | 0.020 |
| Observations | 17,902 | 17,902 | 17,902 | 17,902 |

**Table 3. 4.** Relationship between CEO Departures and Stock price crashes (inclusion of firm related variables)

This table presents regression estimates for the relationship between CEO Departures and one-year ahead stock price crashes. Models (1) to (4) report logistic regression results for CRASH, while models (5) to (8) report OLS regression results for NCSKEW. The dependent variables are measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. The definitions of all the variables are detailed in Appendix. The estimates include year and industry dummies to control time-invariant fixed year and industry-specific effects. All models include a constant and the standard errors are clustered at the firm-year level. Standard errors are provided in parentheses. All continuous variables are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **CRASH** | | | | **NCSKEW** | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 3Y Before | 1.08 | 1.08 | 1.075 | 1.072 | 0.074** | 0.074** | 0.073** | 0.072** |
| | (0.074) | (0.074) | (0.074) | (0.074) | (0.029) | (0.029) | (0.029) | (0.029) |
| 2Y Before | 1.224*** | 1.225*** | 1.222*** | 1.218*** | 0.106*** | 0.106*** | 0.106*** | 0.105*** |
| | (0.067) | (0.067) | (0.067) | (0.067) | (0.028) | (0.028) | (0.028) | (0.028) |
| 1Y Before | 1.229*** | 1.231*** | 1.223*** | 1.219*** | 0.136*** | 0.137*** | 0.136*** | 0.136*** |
| | (0.062) | (0.062) | (0.062) | (0.062) | (0.026) | (0.026) | (0.026) | (0.026) |
| CEO Departure | 1.076 | 1.077 | 1.065 | 1.06 | 0.083*** | 0.084*** | 0.082*** | 0.082*** |
| | (0.063) | (0.063) | (0.063) | (0.064) | (0.026) | (0.026) | (0.026) | (0.026) |
| 1Y After | 0.955 | 0.955 | 0.939 | 0.937 | -0.025 | -0.025 | -0.027 | -0.026 |
| | (0.063) | (0.063) | (0.064) | (0.064) | (0.025) | (0.025) | (0.025) | (0.025) |
| HHI | 0.97 | 0.97 | 0.969 | 0.969 | -0.017 | -0.017 | -0.018 | -0.017 |
| | (0.041) | (0.042) | (0.042) | (0.042) | (0.018) | (0.018) | (0.018) | (0.018) |
| Competitiveness | 1.027 | 1.024 | 1.033 | 1.023 | 0.030*** | 0.028*** | 0.029*** | 0.021** |
| | (0.023) | (0.023) | (0.023) | (0.024) | (0.008) | (0.008) | (0.008) | (0.009) |
| Peer Information | 0.888*** | 0.888*** | 0.887*** | 0.888*** | -0.025** | -0.025** | -0.025** | -0.024** |
| | (0.025) | (0.025) | (0.025) | (0.025) | (0.010) | (0.010) | (0.010) | (0.010) |
| Conservatism | | 0.961 | 0.96 | 0.962 | | -0.022 | -0.023 | -0.018 |
| | | (0.036) | (0.036) | (0.037) | | (0.014) | (0.014) | (0.014) |
| Opacity | | 1.005 | 1.004 | 1.004 | | 0.003 | 0.002 | 0.003 |
| | | (0.021) | (0.021) | (0.021) | | (0.01) | (0.010) | (0.010) |
| Negative Tone | | | 1.051** | 1.047* | | | -0.004 | -0.005 |
| | | | (0.024) | (0.024) | | | (0.010) | (0.010) |
| Positive Tone | | | 1.033 | 1.031 | | | 0.000 | 0.000 |
| | | | (0.020) | (0.020) | | | (0.008) | (0.008) |
| 10K N Words | | | 1.056* | 1.062** | | | 0.016 | 0.020* |
| | | | (0.029) | (0.029) | | | (0.012) | (0.012) |
| 10K Size | | | 1.071 | 1.065 | | | 0.017 | 0.016 |
| | | | (0.059) | (0.059) | | | (0.024) | (0.024) |
| 10K Readability | | | 1.037* | 1.036* | | | 0.012 | 0.011 |
| | | | (0.021) | (0.021) | | | (0.008) | (0.008) |
| Financial Constraints | | | | 0.909* | | | | -0.027 |
| | | | | (0.057) | | | | (0.023) |
| Z-score | | | | 1.039 | | | | 0.037** |
| | | | | (0.024) | | | | (0.010) |
| NCSKEW | | | | 1.023 | | | | 0.012 |
| | | | | (0.019) | | | | (0.008) |
| NCSKEW (*lag* 1) | | | | 1.052*** | | | | 0.018** |
| | | | | (0.018) | | | | (0.008) |
| Control Variables | YES | YES | YES | YES | YES | YES | YES | YES |
| -2 Log L. / $R^2$ adj. | 18,086 | 18,085 | 18,055 | 18,041 | 0.021 | 0.021 | 0.021 | 0.022 |
| Observations | 17,902 | 17,902 | 17,902 | 17,902 | 17,902 | 17,902 | 17,902 | 17,902 |

**Table 3. 5.** Relationship between CEO Departures and Stock price crashes (inclusion of CEO related variables)

This table presents regression estimates for the relationship between CEO Departures and one-year ahead stock price crashes. Models (1) to (4) report logistic regression results for CRASH, while models (5) to (8) report OLS regression results for NCSKEW. The dependent variables are measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. The definitions of all the variables are detailed in Appendix. The estimates include year and industry dummies to control time-invariant fixed year and industry-specific effects. All models include a constant and the standard errors are clustered at the firm-year level. Standard errors are provided in parentheses. All continuous variables are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **CRASH** | | | | **NCSKEW** | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 3Y Before | 1.098 | 1.094 | 1.094 | 1.09 | 0.080*** | 0.080*** | 0.080 | 0.078 |
| | (0.074) | (0.075) | (0.075) | (0.075) | (0.029) | (0.029) | (0.029) | (0.029) |
| 2Y Before | 1.249*** | 1.243*** | 1.244*** | 1.239*** | 0.113*** | 0.113*** | 0.112*** | 0.112*** |
| | (0.067) | (0.068) | (0.068) | (0.068) | (0.028) | (0.028) | (0.028) | (0.028) |
| 1Y Before | 1.257*** | 1.253*** | 1.256*** | 1.245*** | 0.144*** | 0.144*** | 0.144*** | 0.144*** |
| | (0.063) | (0.063) | (0.064) | (0.064) | (0.027) | (0.027) | (0.027) | (0.027) |
| CEO Departure | 1.108 | 1.113 | 1.146* | 1.132 | 0.092*** | 0.099*** | 0.090*** | 0.089*** |
| | (0.065) | (0.066) | (0.082) | (0.082) | (0.027) | (0.027) | (0.034) | (0.034) |
| 1Y After | 0.931 | 0.95 | 0.949 | 0.946 | -0.032 | -0.021 | -0.021 | -0.023*** |
| | (0.073) | (0.073) | (0.073) | (0.073) | (0.029) | (0.029) | (0.029) | (0.029) |
| CEO Age | 0.955** | 0.961* | 0.962* | 0.965 | -0.018** | -0.014 | -0.014 | -0.014 |
| | (0.021) | (0.022) | (0.022) | (0.022) | (0.009) | (0.009) | (0.009) | (0.009) |
| Short CEO Tenure | 1.024 | 1.052 | 1.051 | 1.034 | 0.017 | 0.036* | 0.036* | 0.033 |
| | (0.053) | (0.054) | (0.054) | (0.054) | (0.021) | (0.021) | (0.021) | (0.021) |
| Long CEO Tenure | 1.042 | 1.036 | 1.036 | 1.047 | 0.046** | 0.037** | 0.037** | 0.036*** |
| | (0.046) | (0.048) | (0.048) | (0.048) | (0.018) | (0.019) | (0.019) | (0.019) |
| Female CEO | 1.135 | 1.146 | 1.146 | 1.143 | -0.006 | 0.004 | 0.004 | 0.005 |
| | (0.112) | (0.113) | (0.113) | (0.114) | (0.050) | (0.050) | (0.050) | (0.050) |
| Managerial Ability | 1.03 | 1.028 | 1.028 | 1.030 | 0.020** | 0.018* | 0.018* | 0.016* |
| | (0.022) | (0.022) | (0.022) | (0.023) | (0.009) | (0.009) | (0.009) | (0.009) |
| Dual CEO | 1.007 | 1.006 | 1.006 | 1.000 | -0.004 | -0.008 | -0.008 | -0.008 |
| | (0.042) | (0.042) | (0.042) | (0.043) | (0.017) | (0.017) | (0.017) | (0.017) |
| CEO Stock Incentives | | 1.066*** | 1.066** | 1.066** | | 0.045*** | 0.045*** | 0.040*** |
| | | (0.025) | (0.025) | (0.026) | | (0.010) | (0.010) | (0.010) |
| CEO Option Incentives | | 1.068*** | 1.068*** | 1.058** | | 0.045*** | 0.045*** | 0.039*** |
| | | (0.024) | (0.024) | (0.025) | | (0.010) | (0.010) | (0.010) |
| CEO Ownership | | 0.936** | 0.936* | 0.939** | | -0.037*** | -0.037*** | -0.034*** |
| | | (0.026) | (0.026) | (0.026) | | (0.009) | (0.009) | (0.009) |
| Bonus to Salary | | 0.992 | 0.992 | 0.990 | | 0.025*** | 0.025*** | 0.021*** |
| | | (0.024) | (0.024) | (0.024) | | (0.009) | (0.009) | (0.009) |
| Forced Turnover | | | 0.937 | 0.925 | | | 0.019 | 0.016 |
| | | | (0.122) | (0.123) | | | (0.051) | (0.051) |
| Retirement | | | 0.956 | 0.955 | | | 0.015 | 0.014 |
| | | | (0.091) | (0.091) | | | (0.036) | (0.036) |
| Control Variables | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm-level Variables | | | | YES | | | | YES |
| -2 Log L. / $R^2$ adj. | 18,103 | 18,085 | 18,084 | 18,018 | 0.020 | 0.023 | 0.022 | 0.024 |
| Observations | 17,902 | 17,902 | 17,902 | 17,902 | 17,902 | 17,902 | 17,902 | 17,902 |

**Table 3. 6.** Relationship between CEO Departures and Stock price crashes (inclusion of CEO Overconfidence)

This table presents regression estimates for the relationship between CEO Departures and one-year ahead stock price crashes. Models (1) to (4) report logistic regression results for CRASH, while models (5) to (8) report OLS regression results for NCSKEW. The dependent variables are measured in fiscal year *t*+1, whereby all independent variables are measured in fiscal year *t*. The definitions of all the variables are detailed in Appendix. The estimates include year and industry dummies to control time-invariant fixed year and industry-specific effects. All models include a constant and the standard errors are clustered at the firm-year level. Standard errors are provided in parentheses. All continuous variables are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **CRASH** | | | | **NCSKEW** | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 3Y Before | 1.06 | 1.057 | 1.058 | 1.053 | 0.068** | 0.066** | 0.066** | 0.065** |
| | (0.078) | (0.078) | (0.078) | (0.079) | (0.031) | (0.031) | (0.031) | (0.031) |
| 2Y Before | 1.217*** | 1.210*** | 1.211*** | 1.208*** | 0.103*** | 0.101*** | 0.101*** | 0.101*** |
| | (0.070) | (0.070) | (0.070) | (0.071) | (0.029) | (0.029) | (0.029) | (0.029) |
| 1Y Before | 1.207*** | 1.200*** | 1.2*** | 1.192*** | 0.126*** | 0.123*** | 0.122*** | 0.122*** |
| | (0.066) | (0.066) | (0.066) | (0.067) | (0.028) | (0.028) | (0.028) | (0.028) |
| CEO Departure | 1.083 | 1.083 | 1.102 | 1.089 | 0.091*** | 0.092*** | 0.082** | 0.081** |
| | (0.068) | (0.068) | (0.085) | (0.085) | (0.028) | (0.028) | (0.035) | (0.035) |
| 1Y After | 0.895 | 0.91 | 0.91 | 0.909 | -0.044 | -0.036 | -0.036 | -0.039 |
| | (0.083) | (0.083) | (0.083) | (0.083) | (0.033) | (0.033) | (0.033) | (0.033) |
| CEO Age | 0.957* | 0.963 | 0.963 | 0.966 | -0.013* | -0.009 | -0.010 | -0.010 |
| | (0.023) | (0.023) | (0.024) | (0.024) | (0.009) | (0.010) | (0.010) | (0.010) |
| Short CEO Tenure | 1.05 | 1.075 | 1.075 | 1.059 | 0.042* | 0.056** | 0.056** | 0.053** |
| | (0.058) | (0.059) | (0.059) | (0.059) | (0.023) | (0.024) | (0.024) | (0.024) |
| Long CEO Tenure | 1.025 | 1.018 | 1.018 | 1.026 | 0.036* | 0.031 | 0.030 | 0.030 |
| | (0.048) | (0.050) | (0.050) | (0.050) | (0.019) | (0.020) | (0.020) | (0.020) |
| Female CEO | 1.157 | 1.164 | 1.165 | 1.154 | -0.004 | 0.001 | 0.002 | 0.001 |
| | (0.118) | (0.118) | (0.118) | (0.119) | (0.054) | (0.054) | (0.054) | (0.054) |
| Managerial Ability | 1.039* | 1.039 | 1.039 | 1.041* | 0.025*** | 0.024** | 0.024** | 0.023** |
| | (0.023) | (0.023) | (0.023) | (0.024) | (0.010) | (0.010) | (0.010) | (0.010) |
| Dual CEO | 0.989 | 0.986 | 0.986 | 0.982 | -0.008 | -0.012 | -0.012 | -0.012 |
| | (0.044) | (0.045) | (0.045) | (0.045) | (0.018) | (0.018) | (0.018) | (0.018) |
| CEO Overconfidence | 1.058 | 1.031 | 1.031 | 1.043 | 0.031* | 0.010 | 0.010 | 0.009 |
| | (0.044) | (0.046) | (0.046) | (0.046) | (0.018) | (0.019) | (0.019) | (0.019) |
| CEO Stock Incentives | | 1.063** | 1.063** | 1.069** | | 0.042*** | 0.042*** | 0.039*** |
| | | (0.027) | (0.027) | (0.028) | | (0.011) | (0.011) | (0.011) |
| CEO Option Incentives | | 1.069** | 1.069*** | 1.061** | | 0.044*** | 0.044*** | 0.038*** |
| | | (0.026) | (0.026) | (0.027) | | (0.010) | (0.010) | (0.011) |
| CEO Ownership | | 0.951* | 0.951* | 0.952* | | -0.034*** | -0.034*** | -0.030*** |
| | | (0.027) | (0.027) | (0.027) | | (0.010) | (0.010) | (0.010) |
| Bonus to Salary | | 0.979 | 0.979 | 0.98 | | 0.019* | 0.019* | 0.016* |
| | | (0.026) | (0.026) | (0.026) | | (0.009) | (0.009) | (0.009) |
| Forced Turnover | | | 0.959 | 0.947 | | | 0.020 | 0.018 |
| | | | (0.126) | (0.126) | | | (0.053) | (0.052) |
| Retirement | | | 0.996 | 0.996 | | | 0.028 | 0.027 |
| | | | (0.093) | (0.094) | | | (0.037) | (0.037) |
| Control Variables | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm-level Variables | | | | YES | | | | YES |
| -2 Log L. / $R^2$ adj. | 16,026 | 16,010 | 16,010 | 15,954 | 0.020 | 0.022 | 0.022 | 0.023 |
| Observations | 15,557 | 15,557 | 15,557 | 15,557 | 15,557 | 15,557 | 15,557 | 15,557 |

**Table 3. 7.** Difference-in-Differences Analysis

Each firm that has experienced a CEO Departure in any of the three previous years, is matched with a firm that (i) has operations in the same two-digit industry, (ii) has approximately the same size (proxied by sales) and (iii) has not experienced a CEO Departure in any of the three previous years. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **Mean Difference** | **Observations** |
|---|---|---|
| CRASH | 0.038*** | 4540 |
| | (0.008) | |
| NCSKEW | 0.080*** | 4540 |
| | (0.017) | |
| Total Compensation | -0.025 | 4511 |
| | (0.017) | |
| Bonus | 0.042 | 1755 |
| | (0.031) | |
| Salary | 0.047*** | 4540 |
| | (0.017) | |
| Options | -59.837** | 4535 |
| | (24.065) | |
| CEO Ownership | -0.006*** | 4540 |
| | (0.001) | |
| Shares Unrestricted Excluding Options | -200.200*** | 4540 |
| | (55.540) | |
| Shares | -0.012** | 4540 |
| | (0.005) | |
| Shares Excluding Options | -196.700*** | 4540 |
| | (55.756) | |
| Shares from Option Exercise | 0.128** | 941 |
| | (0.062) | |

**Table 3. 8.** Relationship between Stock price crashes and Corporate Governance

This table presents OLS regression estimates for the relationship between Stock Price Crash and Corporate Governance. The definitions of all the variables are detailed in Appendix. The estimates include year and industry dummies to control time-invariant fixed year and industry-specific effects. All models include a constant and the standard errors are clustered at the firm-year level. Standard errors are provided in parentheses. All continuous variables are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **Independent Directors** | **Female Directors** | **Busy Directors** | **Audit Members** | **Dedicated Inst Investors** | **Transient Inst Investors** |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Before Crash | 0.070*** | 0.054*** | 0.017 | 0.008 | 0.000 | 0.009 |
| | (0.013) | (0.014) | (0.015) | (0.010) | (0.013) | (0.015) |
| Crash | 0.063*** | 0.017*** | -0.022 | -0.004 | -0.010 | 0.027 |
| | (0.015) | (0.016) | (0.018) | (0.012) | (0.014) | (0.018) |
| After Crash | 0.026** | -0.008 | -0.058*** | -0.002 | 0.039 | 0.077*** |
| | (0.013) | (0.014) | (0.015) | (0.010) | (0.013) | (0.015) |
| Size | 0.277*** | 0.136*** | 0.456*** | 0.050*** | 0.041*** | 0.044*** |
| | (0.008) | (0.008) | (0.010) | (0.006) | (0.007) | (0.008) |
| Firm Age | 0.082*** | 0.078*** | 0.026*** | 0.037*** | 0.013* | -0.024*** |
| | (0.008) | (0.008) | (0.009) | (0.006) | (0.007) | (0.009) |
| Market to Book | 0.020*** | 0.026*** | 0.042*** | 0.002 | -0.015** | -0.016* |
| | (0.007) | (0.009) | (0.008) | (0.006) | (0.007) | (0.009) |
| Return on Equity | -0.004 | -0.005*** | 0.015*** | -0.004*** | 0.002* | 0.003* |
| | (0.003) | (0.001) | (0.003) | (0.001) | (0.001) | (0.002) |
| Leverage | -0.042*** | 0.010 | 0.035*** | -0.012* | 0.012 | 0.028*** |
| | (0.008) | (0.008) | (0.009) | (0.006) | (0.007) | (0.009) |
| Capital Expenditure | 0.004 | -0.012 | -0.037*** | 0.007 | 0.002 | 0.006 |
| | (0.007) | (0.008) | (0.008) | (0.005) | (0.007) | (0.008) |
| Earnings | -0.035*** | -0.082*** | -0.104*** | -0.022** | -0.002 | -0.021 |
| | (0.012) | (0.013) | (0.014) | (0.010) | (0.010) | (0.013) |
| Cash Flows | 0.085*** | 0.098*** | 0.049*** | 0.029*** | 0.019* | 0.071*** |
| | (0.013) | (0.014) | (0.014) | (0.010) | (0.011) | (0.014) |
| Litigation | -0.090*** | -0.024 | -0.052 | 0.009 | 0.007 | 0.021 |
| | (0.029) | (0.028) | (0.034) | (0.022) | (0.024) | (0.030) |
| HHI | -0.042*** | -0.094*** | 0.018 | -0.019* | -0.012 | 0.043** |
| | (0.016) | (0.022) | (0.021) | (0.010) | (0.023) | (0.017) |
| $R^2$ adj. | 0.282 | 0.432 | 0.308 | 0.568 | 0.290 | 0.097 |
| Observations | 17,815 | 12,670 | 13,046 | 17,815 | 17,815 | 17,815 |

**Table 3. 9.** Relationship between CEO Departures and Corporate Governance

This table presents OLS regression estimates for the relationship between CEO Departures and Corporate Governance. The definitions of all the variables are detailed in Appendix. The estimates include year and industry dummies to control time-invariant fixed year and industry-specific effects. All models include a constant and the standard errors are clustered at the firm-year level. Standard errors are provided in parentheses. All continuous variables are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **Independent Directors** | **Female Directors** | **Busy Directors** | **Audit Members** | **Dedicated Inst Investors** | **Transient Inst Investors** |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Before CEO Departure | -0.013 | 0.056*** | 0.019 | 0.012 | 0.027* | 0.044** |
| | (0.015) | (0.017) | (0.017) | (0.012) | (0.016) | (0.017) |
| CEO Departure | 0.029 | 0.020 | 0.027 | 0.017 | -0.032 | -0.027 |
| | (0.022) | (0.022) | (0.025) | (0.017) | (0.021) | (0.023) |
| After CEO Departure | 0.054*** | 0.042*** | 0.039** | 0.011*** | -0.010 | 0.014 |
| | (0.015) | (0.015) | (0.017) | (0.011) | (0.015) | (0.017) |
| Size | 0.275*** | 0.132*** | 0.454*** | 0.006*** | 0.041*** | 0.042*** |
| | (0.008) | (0.008) | (0.010) | (0.006) | (0.007) | (0.008) |
| Firm Age | 0.077*** | 0.075*** | 0.025*** | 0.006*** | 0.013* | -0.027*** |
| | (0.008) | (0.008) | (0.009) | (0.006) | (0.007) | (0.009) |
| Market to Book | 0.016** | 0.024*** | 0.042*** | 0.006 | -0.014** | -0.017* |
| | (0.007) | (0.009) | (0.008) | (0.006) | (0.007) | (0.009) |
| Return on Equity | -0.005** | -0.006*** | 0.015*** | 0.001*** | 0.002* | 0.003* |
| | (0.003) | (0.001) | (0.003) | (0.001) | (0.001) | (0.002) |
| Leverage | -0.041*** | 0.012 | 0.035*** | 0.006* | 0.011 | 0.029*** |
| | (0.008) | (0.008) | (0.009) | (0.006) | (0.007) | (0.009) |
| Capital Expenditure | 0.005 | -0.011 | -0.036*** | 0.005 | 0.002 | 0.006 |
| | (0.007) | (0.008) | (0.008) | (0.005) | (0.007) | (0.008) |
| Earnings | -0.039*** | -0.083*** | -0.104*** | 0.010** | -0.003 | -0.022* |
| | (0.012) | (0.013) | (0.014) | (0.010) | (0.010) | (0.013) |
| Cash Flows | 0.091*** | 0.100*** | 0.048*** | 0.010*** | 0.020* | 0.076*** |
| | (0.013) | (0.014) | (0.014) | (0.010) | (0.011) | (0.014) |
| Litigation | -0.087*** | -0.022 | -0.051 | 0.022 | 0.005 | 0.021 |
| | (0.029) | (0.028) | (0.034) | (0.022) | (0.024) | (0.030) |
| HHI | -0.042*** | -0.091*** | 0.021 | 0.010* | -0.012 | 0.042** |
| | (0.015) | (0.022) | (0.021) | (0.010) | (0.023) | (0.017) |
| $R^2$ adj. | 0.281 | 0.432 | 0.307 | 0.568 | 0.290 | 0.096 |
| Observations | 17,815 | 12,670 | 13,046 | 17,815 | 17,815 | 17,815 |

**Table 3. 10.** Relation between CEO Departures with Stock price crashes and Corporate Governance

This table presents OLS regression estimates for the relationship between CEO Departures with Stock Price Crash and Corporate Governance. The definitions of all the variables are detailed in Appendix. The estimates include year and industry dummies to control time-invariant fixed year and industry-specific effects. All models include a constant and the standard errors are clustered at the firm-year level. Standard errors are provided in parentheses. All continuous variables are standardized to have a mean value of zero and variance of one. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

| | **Independent Directors** | **Female Directors** | **Busy Directors** | **Audit Members** | **Dedicated Inst Investors** | **Transient Inst Investors** |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Before CEO Departure with Crash | 0.004 | 0.048** | -0.001 | -0.007 | 0.020 | 0.050** |
| | (0.018) | (0.020) | (0.020) | (0.014) | (0.018) | (0.021) |
| Before CEO Departure without Crash | -0.044* | 0.066** | 0.056** | -0.017 | 0.037 | 0.036 |
| | (0.023) | (0.027) | (0.026) | (0.018) | (0.025) | (0.026) |
| CEO Departure with Crash | 0.074*** | 0.038 | 0.031 | 0.026 | -0.030 | -0.038 |
| | (0.027) | (0.026) | (0.030) | (0.020) | (0.025) | (0.028) |
| CEO Departure without Crash | -0.044 | -0.013 | 0.023 | 0.025 | -0.035 | -0.010 |
| | (0.035) | (0.038) | (0.040) | (0.027) | (0.035) | (0.037) |
| After CEO Departure with Crash | 0.078*** | 0.054*** | 0.008 | 0.036*** | 0.001 | 0.030 |
| | (0.018) | (0.018) | (0.020) | (0.013) | (0.017) | (0.020) |
| After CEO Departure without Crash | 0.019 | 0.020 | 0.076*** | 0.024 | -0.017 | -0.006 |
| | (0.020) | (0.023) | (0.024) | (0.016) | (0.021) | (0.023) |
| Size | 0.277*** | 0.132*** | 0.453*** | 0.050*** | 0.041*** | 0.042*** |
| | (0.008) | (0.008) | (0.010) | (0.006) | (0.007) | (0.008) |
| Firm Age | 0.078*** | 0.075*** | 0.025*** | 0.036*** | 0.013* | -0.027*** |
| | (0.008) | (0.008) | (0.009) | (0.006) | (0.007) | (0.009) |
| Market to Book | 0.017** | 0.025*** | 0.041*** | 0.002 | -0.014** | -0.017* |
| | (0.007) | (0.009) | (0.008) | (0.006) | (0.007) | (0.009) |
| Return on Equity | -0.005* | -0.006*** | 0.015*** | -0.004*** | 0.002* | 0.003* |
| | (0.003) | (0.001) | (0.003) | (0.001) | (0.001) | (0.002) |
| Leverage | -0.042*** | 0.011 | 0.036*** | -0.012* | 0.011 | 0.028*** |
| | (0.008) | (0.009) | (0.009) | (0.006) | (0.007) | (0.009) |
| Capital Expenditure | 0.006 | -0.011 | -0.036*** | 0.007 | 0.002 | 0.006 |
| | (0.007) | (0.008) | (0.008) | (0.005) | (0.007) | (0.008) |
| Earnings | -0.039*** | -0.083*** | -0.104*** | -0.022** | -0.003 | -0.022* |
| | (0.012) | (0.013) | (0.014) | (0.010) | (0.010) | (0.013) |
| Cash Flows | 0.091*** | 0.100*** | 0.048*** | 0.030*** | 0.020* | 0.075*** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | (0.013) | (0.014) | (0.014) | (0.010) | (0.011) | (0.014) |
| Litigation | -0.088*** | -0.022 | -0.051 | 0.010 | 0.005 | 0.020 |
| | (0.029) | (0.028) | (0.034) | (0.022) | (0.024) | (0.030) |
| HHI | -0.042*** | -0.091*** | 0.021 | -0.019* | -0.012 | 0.042** |
| | (0.015) | (0.022) | (0.021) | (0.010) | (0.023) | (0.017) |
| $R^2$ adj. | 0.281 | 0.432 | 0.307 | 0.568 | 0.290 | 0.096 |
| Observations | 17,815 | 12,670 | 13,046 | 17,815 | 17,815 | 17,815 |

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