

PhD Thesis

Title: CEO Overconfidence and Corporate Policy

Ishrar Kibria

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ID: 14342495

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b. Introduction

The PhD thesis consists of three individual but related pieces of research. We extend the literature of CEO overconfidence influence in corporate strategies and provide latest findings on R&D investment, corporate governance structure and HR policy. This PhD thesis adopts empirical method of research, and the results are validated by several robustness checks.

Strategic decisions, according to Hambrick and Mason (1984), reflect senior managers' attitudes and intellectual prejudices. They present the "upper-echelons" theory, which concludes that managerial characteristics, such as those of CEOs, can impact business decisions and organizational performance outcomes (Hambrick and Mason, 1984; Hambrick, 2007). This theory hypothesise that CEOs are boundedly rational. Their personality and ideals are fairly stable, and their choices are inextricably influenced by their personal characteristics (Finkelstein, 1992). Several studies based on upper echelons theory find evidence that CEOs' background characteristics, personality traits, and leadership styles have a significant impact on corporate strategic dynamism (Crossland et al., 2014), R&D spending (Barker and Mueller, 2002), mergers and acquisitions (Yim, 2013), corporate risk-taking propensity (Serfling, 2014), and firm profitability (Wang et al., 2016). A growing field of research demonstrates that a substantial number of senior business executives suffer from overconfidence in their judgements. The willingness of executives to keep their personal wealth undiversified by holding stock options even if they are substantially in-the-money, has been the key measure of executives' overconfidence. The presence of CEO overconfidence, that is, the belief that the firm stock price should be greater than it is, seems to matter for a number of corporate strategies. As documented in the literature, because of the significant impact of CEO and executives' attributes over firm policies, this thesis particularly considers the impact of C-suit Executive Overconfidence on corporate policies. Overconfident CEOs are inclined to inflate their knowledge and control, overestimate the predicted returns, and undervalue the risk of an investment. Overconfident CEOs are described as those who underestimate the volatility of earnings (Hackbarth, 2008) and firm assets (Hackbarth, 2009); or overvalue predicted investment proceeds (Malmendier, Tate and Yan, 2011) and the accuracy of their knowledge (Gervais, Heaton and Odean, 2011). Different aspects of overconfidence are

studied in empirical research (Oskamp, 1965; Weinstein, 1980; and Puri and Robinson, 2007). Moore and Healy (2008) find that literatures are based on three discrete explanations of overconfidence: overestimation (64 percent), over-precision (31 percent) and over-placement (5 percent). Since overconfidence increases alongside the corporate ladder (Camerer and Lovallo, 1999), CEOs and Board members are arguably most susceptible to this bias. We use the overexposure of executives to firms' idiosyncratic risk to construct measures of overconfidence. Executives have substantial stock and option grants embedded in their compensation plan. The stock options are vested, and the firm only allows trading after the period is over. These restrictions make the executives portfolio highly undiversified and risky. As soon as the vesting period is over, a risk-averse executive should exercise their options if the stock price is sufficiently high (Lambert, Larcker and Verrecchia, 1991; Meulbroek, 2001; Hall and Murphy, 2000, 2002). However, some executives persistently choose to hold their stock options because they believe the stock price will increase more in the future. We interpret this behaviour to measure overconfidence following Glasso and Simmcoe (2011) and Malmendier and Tate (2005a, 2008). An overconfident executive takes the value 1 if s/he postpones the exercise of 67 percent in-the-money stock options, and 0 otherwise. Using this technique, if the executive displays overconfidence at least twice, the individual is considered as overconfident for the rest of their tenure. We apply Campbell et al. (2011) for calculating the average moneyness of the executive's option portfolio. For each CEO-year, the average realizable value per option is calculated by dividing total realizable value of the options by the number of options held by him. The strike price is calculated as the fiscal year-end stock price minus the average realizable value. The average moneyness of the options is then calculated by dividing average realisable value by strike price. Majority of the past research on executive's overconfidence, for instance, Malmendier and Tate (2005a, 2008), Glasso and Simmcoe (2011) and Hirshleifer et al. (2012), followed the same approach.

There is a substantial amount of literature that examines the connection between CEO overconfidence and various corporate strategies. Literature document the impact of CEO overconfidence on dividend policy (Deshmukh et al., 2013), investments strategies (Cronqvist et al., 2012; Hackbarth, 2009; Huang and Kisgen, 2013), mergers and acquisitions (Malmendier and Tate, 2008; Yim, 2013), financial risk (Malmendier and Nagel, 2011) and corporate governance (Kim and Lu, 2011, Van den Steen, 2004).

Our first paper extends the work of Francis, Hasan and Sharma (2011) (finds increased innovation with CEO overconfidence), Galasso and Simcoe (2011) (finds 25%-35% more patent citation with CEO overconfidence) and Hirshleifer et al. (2012) (finds increased innovation and patent citations with CEO overconfidence); however, their findings are limited to the year 2003. Also the oscillations of this associations during economic fluctuations have not been studied yet. Our paper fills this gap and document the shifting relation between CEO overconfidence and R&D expenditure during the 2000-01 dot com crash and 2007-08 Global Financial Crisis (GFC). Financial crises limit firms' access to capital, reducing their ability to borrow, causing to cut back on their investment in innovative ventures. We look further to uncover the underlying mechanism and conclude imposed corporate governance as the cause of this shift. Sierra-Morán et al. (2021) and Hoskisson et al. (2002) find negative association between directors who hold more shares and innovation. We complement these findings and conclude that unlike overconfident CEOs, an overconfident board invests less in R&D, more so after the 2000-01 dot com crash and furthermore after the 2007-08 GFC. Due to regulatory enforcements in the post-crash periods (Sarbanes–Oxley Act of 2002, Emergency Economic Stabilization Act of 2008, Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank)), the overconfident board intervenes more in overseeing firms' strategic decisions, which diminishes the positive link between CEO overconfidence and R&D. With empirical support, we take out financial constraints as a potential explanation for reduced R&D spending in post crisis period. We document the novel paradigm shift in corporate governance from CEO to board directors when deciding for R&D investment.

The second paper is developed upon the findings from our first work and looks into the structural formation of corporate governance for firms with overconfident CEOs. We take the discussion further and segment our research question into internal and external components of board structure. For internal element of corporate governance, we look into Board Size, Board Independence (absence of CEO duality), Board Age Demographic and Presence of Co-opted Directors in the Board. For external corporate governance, we investigate the presence of Blockholders and nature of auditor in the firm. We conclude that Board structure of Overconfident CEOs is smaller, less independent and have more younger directors. They also have higher co-opted directors (directors who are hired after the CEO took office) than firms lead by non-

overconfident CEOs. Smaller boards are likely to be intimidated by the CEO, lack of board independence gives CEOs more power, younger directors are typically more risk taker and co-opted directors are likely to assign their allegiance to the CEO. These characteristics of the board implies that overconfident CEOs prefers to lead the board and have control over firms' decisions; and hence likes to keep less crowded structure. For external mechanism of corporate governance, we find lower shareholding and number of affiliated and outside Blockholders in firms lead by overconfident CEOs. Blockholders are large investors (holding more than 5% share of the firm) who have the resource and motivation to implement corporate scrutiny; and having lower concentration of them certainly leaves more power for the CEO. Lastly, firms with overconfident CEOs have lower probability to hire Big 4 or Big 5 accounting firms as their financial auditor. Large audit firms perform quality audits and mitigates managements propensity to interfere with the audit process. By not choosing them, overconfident CEOs retain control over firm financials. Our findings point out the preference of overconfident CEOs for a less forceful board structure and highlights the difference of governance compared to non-overconfident CEOs. There is not enough definite research on the impact of CEO overconfidence on governance processes (Parker, 2017). Through the findings, we are able to clear the ambiguity surrounding corporate governance composition and clarify the unorthodox corporate policies of overconfident CEOs (Malmendier et al., 2011).

Our third paper directly answers to the request for additional research into the role of internal corporate governance, particularly CEOs, in defining HR systems and their impact on an organization's people (Mullins, 2018; Wood and Budhwar, 2021); by looking into the hiring-firing patterns of overconfident CEOs. We apply different measures of net hiring, such as the Employment Growth (which takes the value 1 if net hiring is greater than 1 percent, 5 percent, 10 percent, 15 percent, and 20 percent), and the Employee Reduction (which takes the value 1 if net hiring is less than 0 percent, -1 percent, -5 percent, -10 percent, -15 percent, and -20 percent). We use a number of control variables, year and industry fixed effects in our testing to control for time-invariant industry level effects. We conclude that overconfident CEOs have higher job growth and lesser downsizing in their companies. To assess the hiring pattern during industry expansion-contraction, we use four methods of expansion and contraction, along with their CEO overconfidence interaction as a control to determine the impact.

First, we use industry expansion, which takes the value 1 if the industry's sales median over the last three years is greater than zero. We find that the interaction coefficient for overconfident CEOs is significantly positive for net hiring and employment growth, and significantly negative for Employee Reduction. Second, we employ rolling cash flow volatility, which calculates the standard deviation of industry cashflow over the previous five years. With the industry's high cash volatility, we find that overconfident CEOs hire more and fire less than their counterparts. Third, we divide the sample into three equal sub samples using the firm Kaplan Zingales index. We ran separate analyses and argue that when a company's finances are tight, CEO overconfidence has a greater influence and is a substantial positive for employment growth. Lastly, we split the sample into three groups based on the total asset value and discover that overconfident CEOs are more likely to have higher employment growth in smaller enterprises. They do, however, have more recruitment in three sub-samples, but have higher influence in smaller businesses. Our findings contribute to the ongoing discussion on the value implications of over-hiring and under-firing decisions, alongside CEO risk preferences. According to certain studies, when CEOs choose the quiet life (Bertrand and Mullainathan, 2003), engage in empire building (Pagano and Volpin, 2005), or seek private rewards associated with creating relationships with people, sub-optimal investments in human resources are destructive (Atanassov and Kim, 2009; Landier et al., 2009). However, the actions of overconfident CEOs may add value, not only because retaining workers during a bad economy saves firms money in employment adjustment costs, retains firm-specific human capital, and boosts morale; but it also allows firms to be prepared for future growth opportunities, which is consistent with the concept of maintaining optimal investment in employees (Falato and Liang, 2016; Ellul et al., 2018).

Our findings reveal novel relationship between CEO overconfidence and various corporate and governance policies. We contribute to the literature an empirical framework to help integrate and evaluate the growing research on CEO overconfidence. Our first paper adds to the literature on CEO overconfidence by presenting the most recent research on the shifting relation between CEO overconfidence and innovation. Ours is one of the first efforts to look at both the 2000-01 dot com bubble crash and 2007-08 GFC and discover increased board dominance in post crisis era. This strengthen governance is the evidence of successful incorporation of Sarbanes–Oxley

Act of 2002, Emergency Economic Stabilization Act of 2008, Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank) and gives assurance to investors about prevention of another crisis due to poor monitoring. Investors rights are now stronger due to board intervention and close scrutiny. On another view, the vibrant and positive relationship between CEO overconfidence and innovation between crashes relevant to investors who are interested in investing in innovative and growth firms. Investors are now better-off and well-guarded with stronger governance in firms headed by overconfident CEOs.

Taking the study further, our second paper investigates the internal and external determinants of corporate governance for overconfident CEOs, particularly focusing on board structure. Boards have substantial impact on shaping an organizational culture and governance (Lightle et al., 2009). Overconfident CEOs have unique board formation which could help in explaining their non-conventional corporate strategies. Our findings suggest that strong internal control may limit CEO decision-making ability, as since firms decision making process is highly standardized. However, if a company's internal control is inadequate, it may result in a rise in agency costs, impeding innovation's efficiency and productivity. Our findings add to the understand of the firm's central agency problem, specifically the separation of ownership and control. Equity based compensation might help to minimize typical CEO incentive misalignment but fails to reduce agency cost. These findings aid investors with a probable reasoning on why firms with overconfident CEOs might incur reduced agency costs due to CEO power dominance, however there prevails a probability of more risky investments and skewed earnings manipulation.

Our third paper contributes to the expanding literature about company HR policy, and we investigate how CEO overconfident impacts firms hiring-firing decisions. We show that overconfident CEOs hire more employees and have a positive employment growth over time when using multiple hiring and firing criteria. We also find the increased influence of CEO overconfidence for smaller and financially constrained firms. Retaining workers in the bad time saves employment adjustment costs, retains firm-specific human capital and boosts morale. Investors of such firms could expect to be better prepared for future growth opportunities. In this context,

CEO’s preferences could become more closely aligned with those of the employees and of the shareholders.

Paper 1

CEO Overconfidence and Innovation: The Role of Board of Directors pre- and post-Financial Crisis

Abstract: This paper explores the shifting association between CEO overconfidence and R&D expenditure during the 2000-01 Dot Com Crash and 2007-08 Global Financial Crisis (GFC). Up until now, research findings suggests that overconfident CEOs invest more on R&D. However, we discover this association to change and fluctuate overtime. To explore the underlying mechanism of this dynamic relationship between, we investigate the interplay of two economic crashes and corporate governance on the association. In particular, we find that overconfident board (excluding CEOs) invests less in R&D and their increased dominance in post-dot com crash and post-GFC period weakens the positive relationship between CEO overconfidence and R&D. The overconfident board makes extra intervention in post-crash period in supervising R&D investment decision, which diminish CEO overconfidence' positive effect. With empirical support, we eliminate firm financial constraints as a probable alternative explanation for reduced R&D expenditure. Our results are robust for different measures of overconfidence.

JEL classification codes: G02; G32; G34

Keywords: Overconfidence; R&D; board dominance; corporate governance; dot com crash; financial crisis

1. Introduction

Successful innovation leads firm's growth (Grossman and Helpman, 1991) and provides sustainable competitive advantage (Schumpeter, 1950). However, innovation is associated with higher level of ambiguity and failure (Bhagat and Welch, 1995; Kothari et al., 2002), and are subject to administrative approval, management strategies, corporate governance and available internal and external financing.

This paper relates to the rich literature that examines the effect of executives' characteristics on innovation. Aghion et al. (2005) highlight the competitive pressure to innovate in Schumpeterian theory and point out that the flow of corporate innovation depends on how human and physical resources are integrated within the firm. Among the many managerial biases identified in the literature, overconfidence is regarded as the most pervasive (Moore and Healy, 2008). Furthermore, it has been demonstrated that overconfidence has a direct impact on how people process and interpret information, which in turn affects how they make decisions (Astebro et al., 2007; Chen et al., 2015). Hirshleifer et al. (2010) show overconfident CEOs are associated with higher R&D expenditure and patent citations, and their findings are strong for both options and press-based measures of overconfidence. Similarly, using patent citation as a measure of effective innovation, Galasso and Simcoe (2011) find a 25%-35% premium in patent citations for overconfident CEOs, and also a positive association of CEO overconfidence and R&D spending. Sunder et al. (2017) identify sensation seeking personality trait of pilot CEOs to drive innovation success. Tang et al. (2015) document positive correlation between firm innovation and executive hubris.

Mao and Zhang (2016) find lowered managerial risk-taking incentive after FAS 123R implementation reduces firms' innovation projects. Innovation outputs decreases when CEOs' risk-taking incentive is curbed, highlighting executives risk-taking behaviour as a key driver for innovation. Existing studies have significantly improved the understanding of executives' characteristics on innovation; however, it lacks recent evidence on the topic and to-date, none has considered the influence pattern of overconfidence and innovation during bullish vs bearish market. Investment in R&D is risky, and the results take time to materialize. Hence firms with financial difficulties are prone to decrease their R&D spending during recessions (Schumpeter, 1939;

Freeman et al., 1982). During recessions, R&D spending may also be reduced due to a decline in demand (Stiglitz, 1993; Aghion and Saint-Paul, 1998). Additionally, research has indicated that firms are less responsive to legislative initiatives during periods of economic instability (Bloom et al., 2007; Bloom, 2008). Because uncertainty increases the actual option value of investments, firms become more cautious when deciding how much money to spend on R&D during recessions. Our paper addresses this gap by analysing overconfident CEOs innovation pattern through 2000-01 dot com bubble and 2007-08 financial crisis, while integrating corporate governance of board overconfidence into consideration.

An Alan Greenspan speech from December 5, 1996, is credited with helping to create the dotcom bubble. The irrational exuberance of the financial market was predicted to bring down the market but was instead hailed as a powerful signal of confidence, something Greenspan, the then-chairman of the US Federal Reserve, cautioned about. A growing body of research has also looked at how Internet businesses fared during the stock market bubble that lasted from 1996 to 2000. Investors flocked to the internet sector by seeing stock prices soar in the hopes of reaping enormous returns. In mid-2000, the boom ended and the bubble burst. As businesses collapsed one after another, the stock values of the internet industry fell precipitously for 2.5 years. The dot-com boom had such a profound effect that when it burst in 2000, the stock market crashed. The dot com crash was caused by investors' fear of missing out, their overestimation of the profitability of technological businesses, and the abundance of venture money for startups. The fluctuation of technology stocks was one of the key causes of the catastrophe. Investors made no proper planning regarding the business, the products, or the track record of revenues despite their eagerness to reap gains. After exhausting all of their capital, they had nothing left, and their businesses failed.

Ofek and Richardson (2003) show that the limited market ability to short Internet stocks during the bubble period led to a higher market valuation of Internet companies. Pastor and Veronesi (2006) contend that the late 1990s, Internet bubble was not irrational but rather the outcome of significant stock price volatility brought on by uncertainty regarding average future business profitability. They claim that during the bubble era, the trading volume, market-to-book ratio and the implied volatility all were high for Nasdaq businesses. According to Bharath and Viswanathan (2006), the bubble

burst caused U.S. publicly traded Internet corporations to lose close to $428 billion between March and December 2000. In a similar vein, O'Brien and Tian (2006) draw the conclusion that throughout the 1990s boom period, experts were more upbeat in their recommendations for Internet companies than non-Internet. These studies imply the significance and involvement of Internet businesses in the 1990s stock market bubble. The discussions above indicates that NASDAQ-listed firms faced more fierce consequence of the crash due to their nature. To address the difference in attributes between NYSE and NASDAQ, we conduct separate analysis of both exchanges.

Soon after the dot com crash, the housing building prices started to rise creating a global recession in 2007. The financial crisis of 2007-08 was the worst since the 1929 crisis (Carvalhal and Leal, 2013). Companies credit capacity reduced during the period, along with higher costs of external financing and difficulty in granting or renewal of credit lines towards financial bodies (Dang et al., 2014; Drobetz et al., 2015). It is empirically established that in response to the reduction in bank credit supply (Ivashina and Scharfstein, 2010; Iyer et al., 2014; Liberti and Sturgess, 2018), firms have reduced their labor demand (Chodorow-Reich, 2014), investment (Cingano et al., 2016; Vermoesen et al., 2013) and trade activities (Chor and Manova, 2012). Policymakers in many industrialized nations, notably Austria, Denmark, and Sweden, reacted swiftly to the crisis and increased the public R&D budgets in order to prevent businesses from cutting their R&D expenditures and to sustain the national R&D capacities (OECD, 2012b). The commercial sector in Germany cut R&D spending by 2.9%, while the German Federal Ministry for Education and Research (BMBF) responded to the crisis by raising its budget by 9% in 2009 as compared to 2008. US financial system collapsed with the bankruptcy of several financial institutions in the country, which directly affected firms' credit line (Campello et al., 2010; Caprio et al., 2014; Graham et al., 2015).

Overconfidence will affect CEOs views on how to estimate the risk and predict the future return. As we discussed before, overconfident CEOs over/under-estimating the likelihood of good/bad outcomes and/or overestimating their own ability in obtaining good outcomes (Weinstein, 1980; Alicke et al., 1995). However, there is limited study on whether overconfident CEOs' optimistic views are affected by external environments. We are interested in whether overconfident CEOs show more

managerial risk-taking and challenging activities when the whole external environment is in a bad condition. The dot com bubble and GFC provide the perfect opportunity for us to investigate whether the impact of CEO overconfidence on innovation is affected by external environments.

Both the dot com bubble and GFC jeopardized firm liquidity and free cash flow, which is one of the most important factors for any investment, more so in R&D because of uncertainty associated with it (Brown et al., 2009 and Faleye et al., 2011). Hence firm innovation is very likely to be impacted due to these crises and therefore in line with our interest we look towards the projecting changes in recognized association of innovation and CEO overconfidence. Empirical evidence on how CEO overconfidence affects a firm's innovation after an economic crisis is missing. Therefore, some critical questions for the proper post-crash policy design of firms' innovation and CEOs have not been answered. In this regard, our research findings aim to provide guidance for policy makers to optimize firm resources.

This study utilizes the data of US publicly traded firms from January 1993 - December 2017 to investigate the association. First, we explore, does the effect of CEO overconfidence on firm's innovation fluctuates during economic turmoil? The regulatory reforms are well monitored across the globe following the 2000-01 dot com crash, which further got tougher after 2007-08 financial crisis. While corporate governance appears to react strongly to developments in the business environment, e.g., landmark changes in the institutional framework of governance from Cadbury (1991) in the UK through Sarbanes-Oxley (2002) and Dodd-Frank (2010) in the US to more recent post-2008 reforms in Europe and elsewhere, the questions is whether the regulatory changes bring any impact on corporate practices, and if yes, the mechanisms remain unexplored. Our results show that there is a significantly positive relation between CEO overconfidence and innovation before and during the dot com bubble, however this link diminishes following the crash and eventually turns negative afterwards.

Second, we explore an uncharted element of corporate governance; overconfidence of board directors and investigate whether and to what extent the overconfidence of board directors has influenced the link between CEO overconfidence

and innovation. Strengthening the argument of Herrmann et al. (2010), Cebula and Rossi (2015), and Rossi and Cebula (2015), who concludes lower innovation for directors holding more shares; we also find lower R&D for overconfident board, more so after 2000-01 dot com crash and 2007-08 GFC. With enforced regulatory mandates after the economic crashes, board intrusion increases which results in the alteration between CEO overconfidence and R&D investment. Our results demonstrate that one of the mechanisms of the reformed connection between CEO overconfidence and innovation between sample periods are the strengthened supervision from the overconfident board members, which provides a novel viewpoint to understand how corporate governance interacts with economic crisis and affects CEOs' investment decision.

Our findings contribute to the literature in three important ways. First, we contribute to the literature on CEO overconfidence and unveil the transforming association between CEO overconfidence and innovation. Prior research finds that overconfident CEOs are positively associated with corporate innovation (Galasso and Simcoe, 2011; Hirshleifer et al., 2012), but they focus on a single period and does not consider the economic crashes. To the best of our knowledge, our research is among the first that covers both dot com crash and global financial crisis periods to highlight the changes. Second, the findings have significant business and policy implications. We find the relationship between CEO overconfidence and innovation is vibrant between crashes. This inference is relevant to investors who are interested in investing in innovative and growth firms. Third, our findings also indicate that overconfident boards strengthen their monitoring and scrutiny on corporate strategic investments after the 2000-01 dot com crash, indicating more transparency over firms' fundamentals.

2. Literature Review

2.1 Behavioral Corporate Finance

The earlier investigations emphasize that markets are not always rational. In fact, a rather contentious line of research in the field of finance contends that rather than the efficient market theory, human behavior traits may really be the primary driver of

markets. When developing and testing behavioral models, such as the idea of momentum strategies, Jegadeesh and Titman (2001, 1993) discovered evidence that investors frequently overreact to momentum. In other words, when markets are rising, people tend to buy more than they should and, conversely, when markets are falling, people prefer to cling on and not sell when they should.

Behavioral finance combines financial theories with personal traits to reach more conclusive undrstanding of the industry. With the introduction of behavioral finance, the Efficient Market Hypothesis' hegemonic position as a theoretical framework for investment came to an end. These two strategies have been at odds with one another ever since. The psychology of an investor and their skewed behavioral rules are in direct conflict with investment rationality and efficient market theories. However, slow access to investment information and long-term market anomalies offers proof of the importance of behavioral finance.

Baker and Wurgler (2002) make an effort to challenge conventional finance literature that instruct that the decision between debt and equity is a trade-off between interest tax shields and bankruptcy costs. They demonstrate that the decision between debt and equity seems to depend on whether management believe their company is overvalued. A company's financing strategy is essentially the result of management' cumulative past attempts to time the market. Financing with equity during historically high market to book ratio times explains a significant portion of the equity portion. Welch (2004) contends in a further key work that businesses do not alter their capital structures in response to changes in market price. This goes against theories of rational capital structure selection.

Stulz and Williamson (2003) make an intriguing application of sociological theories when they claim that a nation's culture affects creditor rights. They discover that Catholic nations have worse creditor protection, indicating that Catholicism's long-standing resistance to capitalism and private property is to blame for this phenomena. But there is still a lot of work to be done in this area. In more detail, it is yet unknown if cultural differences can account for regional differences in other facets of corporate finance, such as the structure of governance, CEO compensation, and labor protection.

The continued use of dividends despite the fact that share repurchases as a method of cash distribution have tax advantages has long been a mystery in corporate finance. The literature on behavioural dividend policy dates back to Shefrin and Statman (1984), who claimed that firms pay dividends simply because investors exercise better self-control with their expenditures if they receive a "check in the mail" in the form of a dividend than if they have to take a conscious action (sell shares), as the latter may allow for a more rapid liquidation of the portfolio than is desirable. More recently, Baker and Wurgler (2004) rationalize dividends by contending that investors sometimes desire payouts more than other times. Empirical discrepancies in the market to book ratios of companies that pay dividends and those that don't can be used to measure the demand. They contend that the empirical proximate for dividend desire can successfully account for differences in dividend policy over time.

Benefits from synergy of two businesses are the most sensible justification for doing merger activity. The continuing conundrum has been why targets get greater returns following takeover activity while acquiring firms do not (early work by Jensen and Ruback (1983), Bradley et al. (1983), and Asquithet al. (1983) provides a good summary of the data). According to Roll (1986), this occurs because bidders have "hubris," or they just overestimate merger benefits and overpay for the target. More recently, by Malmendier and Tate (2005) found evidence of CEO overconfidence to clarify the profit puzzle surrounding mergers and acquisitions.

2.2 Overconfidence

Behavioural finance uses non-rational investor behavior to explain financial events. Latest development in this sector aims to connect the decision-making of top executives with their behavioral traits, such as their level of confidence. The proponents of behavioural corporate finance contend that psychological factors affect the traditional paradigm of corporate finance, which is based on the company's value-based management and the three conditions of rational behavior, the fixed asset pricing model, and efficient markets (Shefrin, 2001). It is thought that psychological factors prevent people from making fully rational decisions and that fundamental value is not reflected in stock market pricing. In terms of investor irrationality, it can be said that

numerous studies on cognitive psychology have demonstrated that investors who are overconfident in their knowledge and abilities consistently make mistakes in their reasoning and decision-making, placing too much weight on recent experience, among other distortions.

From social psychology literature, overconfidence can be termed as “better-than-average” effect. Executives are seen to portray overconfidence, both in the better-than-average effect and narrow confidence intervals (Larwood and Whittaker, 1977; Kidd, 1970). This finding can be linked with three main factors of overconfidence: a) the misapprehension of control, b) higher assurance to good outcomes, and c) intangible reference points which makes it difficult to compare performance across individuals (Weinstein, 1980; Alicke et al. 1995). These three factors provide rationale to why CEO overconfidence affects corporate investment. While selecting an investment project, overconfident CEOs are likely to believe their control on the outcome and underestimate the probability of default (March and Shapira, 1987; Langer, 1975).

Overconfidence is a well-researched bias in the psychology of judgment that easily permeates the literature on finance. Even though the idea of overconfident investors seems to have some initial appeal in characterizing the actions of players in the financial market, recent research points to the existence of more complicated underlying factors. At least three different occurrences fall under the umbrella of overconfidence, which can be referred as "categories of overconfidence". We use the vocabulary of Moore and Healy (2008) to analyse these various categories and make the distinction between overestimation, overplacement, and overprecision.

i. Overestimation: When it comes to their performance or aptitude in general, people might be overconfident. They exaggerate their own performance, such as how well they will perform on an exam or how long it will take them to complete a marathon (Grieco and Hogarth, 2009). Performance assessments before or after experimental tasks in which participants answer general knowledge questions frequently show overestimation (Lichtenstein et al., 1982). The degree of overestimation rises with work difficulty and personal relevance (Frank, 1935; Moore and Healy, 2008). Investment scores highly on both criteria, therefore we anticipate a significant overestimation of financial achievement. This prediction acknowledges that overestimation is context-

specific and that it is not a universal phenomenon (Moore and Healy, 2008; Blavatskyy, 2009; Clark and Friesen, 2009).

ii: Overplacement: Overplacement is the opposite of overestimation when it comes to relative comparisons within a group. The better-than-average (BTA) effect defines the propensity to regard oneself as above average in several fields (Alicke and Govorun, 2005). As an illustration, approximately 90% of US drivers in a sample say they drive more safely than the typical person (Svenson, 1981). The BTA effect can be found in assessments of abilities and skills as well as personality traits (Alicke et al., 1995). Even while BTA decisions are frequently made, they are not always the case. They may disappear or even reverse for unfamiliar or challenging activities, in contrast to overestimation (Kruger, 1999; Moore and Cain, 2007; Moore and Healy, 2008; Clark and Friesen, 2009). This emphasizes once more how context-dependent overconfidence measurements are. Benoît and Dubra (2011), who show that high fractions of persons seeing themselves as Better Than Average (BTA) might be rationalized, have called into question results on the BTA effect more broadly. Later investigations with improved measurement (Merkle and Weber, 2011; Burks et al., 2013; Benoît et al., 2015), have confirmed true overconfidence. The BTA effect typically only applies to a population as a whole and does not suggest overconfidence on an individual level. This necessitates contrasting the concept with the precise location within a domain. The difference between the two positions then serves as a proxy for the degree of overplacement (Larrick et al., 2007). BTA judgments are a good substitute for overplacement in the absence of significant skill differences.

iii. Overprecision: When estimating unknown values, particularly when determining the ranges within which a value is likely to fall, overconfidence of this kind can also arise. Regardless of whether general knowledge questions (such as "length of the Nile," Russo and Schoemaker, 1992) or financial values (such as "value of the Dow in one year", Glaser et al., 2013) are the target of the estimation, people typically show overprecision and submit far too narrow intervals (Alpert and Raiffa, 1982; Klayman and Soll, 2004). Indicating severe overprecision, less than 50% of the true values frequently fall within 90% confidence ranges. Financial inducements and various answer styles have been proposed as ways to lessen overprecision (Cesarini et al., 2006). Underprecision is uncommon, though, according to (Moore and Healy, 2008).

2.3 Overconfidence and its Variations Over Time

The most common bias that depends on the fundamentals of volatile beliefs is overconfidence (Akerlof and Shiller, 2009). According to the behavioral literature, it is one of the most conclusive behavioral results and a long-lasting dynamic phenomenon (Shefrin, 2008). Overconfident people overstate their level of expertise, underestimate risk, and are too sure of the success (Massey and Thaler, 2005). While there are no literature on managerial overconfidecnce flactuations, few exists focusing on the investors' overconfidence flactuations with the market. These psychological traps cause investor misconceptions about the fundamental value of stocks to autocorrelate (De Grauwe, 2012), accelerating stock mispricing and igniting market bubbles. Overconfidence is described by Shiller (2000) as trading excessively. Additionally, a number of scholars (Authers, 2010; De Grauwe, 2012; Akerlof and Shiller, 2009) contend that overconfidence is the primary driver of investors' changing beliefs and is a key component in causing and riding bubbles. The investors overvalue the accuracy of their knowledge and underestimate the possibility of severe events because they are overconfident in their ability to choose profitable stocks. As a result, they engage in more excessive trading on winning stocks in a bull market than a bear one, pushing stock prices above their intrinsic values and causing a steady departure from their fundamentals values. Such conduct results in an unusual rise in stock volatility (Chuang and Lee, 2006; Ben-David et al., 2010; Shefrin and Statman, 2011).

There has been some empirical research on the scale of the impact of investor overconfidence on investment decisions in the European and American markets. Similar to investors, we expect overconfident CEOs and board directors to invest considerably more in a bullish market; e.g., during the rise of dot com bubble and housing crisis. However, there is little research of the impact of dynamic overconfidence on the development of global financial markets during economic flactuations. We adress this limitation in the paper and document the varrying effects of overconfidence on R&D decisions. To account for this variation, we divided our sample period into five sub-samples and investigated overconfidence flactuations over-time during varying market condition.

2.4 Overconfidence and Innovation

An intriguing research by Gervais and Goldstein (2004) argues that overconfidence may facilitate improved organizational performance. The idea is that everyone's marginal production in the team is dependent on everyone else. An overconfident agent can overestimate his marginal production and work longer hours, which would make others work longer hours as well. The organization as a whole can profit from the positive externality that other players produce, even while overconfidence makes the agent work too hard.

Scholars have studied the impact of managerial overconfidence on investment behaviours. Literature documents that overconfident CEOs underestimate the volatility of earnings (Hackbarth, 2008) and assets of firms (Hackbarth, 2009) or overestimate expected proceeds from investment (Malmendier et al., 2011) and accuracy of information (Gervais et al., 2011). Malmendier and Tate (2003) show that overconfident CEOs are more likely to conduct mergers and acquisitions. Hackbarth (2009) integrates the behavioural perspective with earnings-based models of corporate borrowing and shows that in real options frameworks, debt overhang or underinvestment problem and risk shifting and asset stripping can be alleviated by managerial overconfidence. This finding is consistent with the timing effect of managerial overconfidence, which states that overconfident managers invest earlier and more compared to rational managers. CEOs filter external and internal factors based on their beliefs and morals (Hambrick and Mason, 1984). Therefore, the interpretation of a situation will differ among individuals. Hambrick and Mason (1984) argue how use of information in decisions will depend on managers work experiences and educational background. Fiske and Taylor (1991) complement this finding. Hayes and Abernathy (1980), Hambrick and Mason (1984) and Hayes et al. (1988) find the association between these two with commitment to innovation.

Empirical evidence also shows association of CEO overconfidence with corporate decisions such as merger and acquisitions, cash flow volatility and overinvestment. Malmendier and Tate (2008) finds CEO overconfidence to clarify the merger and acquisition (M&A) decisions, while Billett and Qian (2008) documents its association with M&A frequencies. Overconfident CEOs tend to overestimate the

discounted expected cash flow from risky decisions. They have the delusion of control in outcomes and are seen with a propensity to forecast positive results. Furthermore, overconfident CEOs are more optimistic about their positive performance from hard task rather than easy one (Griffin and Tversky, 1992). Therefore, overconfident CEOs are especially eager to undertake risky, innovative and challenging work. Einhorn and Hogarth (1981) finds that overconfidence in individual rises with time and gets more severe with vague and delayed feedback. Investing in R&D ties up fund for considerably long period of time and profits are realized very lately. Hence overconfidence is likely to have an crucial influence on R&D.

Both empirical evidence and numerous narratives show that CEO plays an important role in determining a firm's innovation. A CEO can affect R&D input and output by altering compensation schemes for innovation (Lerner and Wulf, 2007), employing likeminded people in the organization (Van den Steen, 2005) and forming the top management team who have higher willingness to innovate (Zahra and Pearce, 1989). An example can be drawn from the tenure of Lou Gerstner, CEO of IBM (1993-2002), during which a surge in patenting was observed that increased firm's earning from licensing revenue. It is believed that the increased innovation outputs are driven by Gerstner's extending of IBM's research line to explore software and supercomputers and setting targets for the R&D department and rewarding successful innovators.

Empirical researchers, such as, Galasso and Simcoe (2011) find that overconfident CEOs generate 25%-35% more patent citation than non- overconfident CEOs. They also find a similar link with overconfidence and R&D spending. Hirshleifer et al. (2012) find that firms with overconfident CEOs invest more in innovation and obtain more patent and patent citation. Concluding from the literature, we hypothesize that,

H_1: Overconfident CEOs invest more in R&D

However, Hirshleifer et al. (2012) study is limited by the data for patents from National Bureau of Economic Research (NBER), which was available till year 2006. Francis et al. (2011) document an increase in innovation with increased CEO compensation, measured by stock option grants and golden parachutes. But these researchers do not consider economic fluctuations in the analysis. The economic

literature has provided a variety of perspectives on how a recession affects innovative activity. According to one body of research, R&D expenditure should follow countercyclical behavior. Profitability declines during economic downturns push businesses to look for ways to boost productivity. However, due to the low demand for goods and services, reallocating productive assets from manufacturing to R&D has very low opportunity costs, which is consistent with the Schumpeterian theory of creative destruction (Stiglitz, 1993; Aghion and Saint-Paul, 1998).

The alternative viewpoint argues that innovation behavior is procyclical. Demand is a key factor in innovation because there is no motivation to launch new items if demand is low (Schmookler, 1966; Shleifer, 1986). Additionally, R&D is frequently funded by the company's free cash flow, which is based on current profit, so financial constraints during an economic slump cause investment in R&D to decline (Hall, 1992; Himmelberg and Petersen, 1994; Harhoff, 1998; Rafferty and Funk,2008).

Regulatory reforms have vastly changed after 2000-01 bubble crash, similar to how it transpired after 2007-08. After Enron scandal, the role of internal control systems has been prioritised. For example, one requirement of Sarbanes-Oxley is that CEOs and CFOs declare their financial statements. The recession following 2007-08 crisis has been unparalleled since the Great Depression in terms of its quickness, severity, and cross-country impact (Eichengreen and O'Rourke, 2009). The rate of financial markets contraction and asset prices fall was faster than ever in post-war times. The initial federal judicial response was the Emergency Economic Stabilization Act of 2008, which sanctioned the Treasury Department to establish a Troubled Asset Relief Program (TARP) to buy distraught assets from financial institutions. The program forced firms receiving TARP funds to comply with a number of corporate governance rules. Congress further passed the Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank). This law had provisions like mandatory independent compensation committees and the separation of the CEO and board chairman positions. Such provisions were made to ensure directors have all information necessary to get involved in decision making. With disclosure of more information, it made directors legally responsible to monitor and intervene in firms' policy. For this reason, we incorporate the dotcom crisis of 2000-01 and financial crisis of 2007-09 to the analysis to

investigate governance effect on CEO overconfidence and firm innovation. Based on the discussion above, we hypothesize that,

H_2: The positive relationship between CEO overconfidence and R&D investment is more likely to be present during dot com bubble period, and the positive relationship may disappear during and post dot com crash

2.5 Regulatory Reforms: Effects on CEO overconfidence and Innovation

After the 2000-01 dot com crash, the government had taken number of measures to regulate internal corporate governance as well as the securities markets, e.g., the Sarbanes-Oxley Act of 2002 and the New York Stock Exchange and NASDAQ new listing rules, which govern director independence. These reforms constitute marks the greatest significant increase in federal regulatory power over corporate governance. According to critics in 2003's International Financial Latino Review, this contentious law is the most significant since the 1934 Exchange Act.

Arthur Levitt, the chairman of the SEC, discussed the development and efficiency of corporate governance in a speech in December 2000. He emphasized that the financial crisis in emerging markets, which implicates a lack of corporate and governmental monitoring, has brought corporate governance to an extraordinary level of public attention and industry awareness.

President George W. Bush signed the Sarbanes-Oxley Act on July 30, 2002. It was regarded as one of the largest revisions to federal securities laws and corporate governance standards in US history (Akin et al., 2002). The Sarbanes-Oxley Act of 2002 made significant changes to public company governance, including requirements for auditor independence, the function of the audit committee, the minimum requirements for independent directors, and a number of other legal changes aimed at safeguarding the public and investors (Gallagher, 2002). The Sarbanes-Oxley Act aims to stiffen penalties for securities law infractions as well as other offenses, encourage corporate responsibility, boost public exposure, and improve the caliber and transparency of financial reporting and audits.

Along with the effects of the equity and debt markets, corporate governance mechanisms such as the traits of the board of directors, the CEO's incentives and compensation plans, and corporate internal control are also anticipated to have a significant impact on how firms approaches innovation. It is expected that the radical changes in corporate governance brought about by the enactment of SOX will have broad-reaching and significant effects on corporate policies. For instance, Johnston and Madura (2009) investigate how SOX affects companies' decisions to go public as well as the first returns of IPOs both before and after SOX. Dalton and Dalton (2008) investigate how SOX affects executive compensation. The effect of SOX on corporate earnings management is examined by Cohen et al. (2008).

There are a number of reasons why the SOX may hinder corporate innovation. First, managers may have less discretion and flexibility due to the potential extensive and more effective monitoring from directors required by SOX, which might have a negative impact on company innovation. Second, managers of firms that have improved corporate governance as a result of SOX may be reluctant to undertake innovative projects due to concerns for their careers and a fear of failure. CEOs are more likely to be fired when innovation programs fail.

Further major governing changes took place in the aftermath of 2007-08 crisis. To help recover the economy, Emergency Economic Stabilization Act of 2008, Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank) were implemented. As argued by Reinhart and Rogoff (2014), after the systemic financial crisis in 2007-08, there has been a prolonged productivity decline due to persistent demand and supply scarcity. Anzoategui et al. (2017) construct a macroeconomic model of the US economy and demonstrate that a decline in R&D spending and technology adoption was the root of the productivity slowdown that followed the 2008–2009 financial crisis.As per IMF, 2010; the region's GDP decreased by 1.9% in 2009 and fixed investment was expected to decrease by 13.6% as a result of credit tightening and demand uncertainty.

Investments in innovations tend to be procyclical and considerably decline throughout recessions (OECD, 2009b; Francois and Lloyed-Ellis, 2003). Because of uncertainily, firms forecast lower demands and cuts R&D first to focus investments on more current needs. Additionally, undertaking an innovation project might no longer

be appealing to firms due to the possibility of considerably lesser rewards in the event that it is successful if demand is low. Based on the literature review and discussion above, we hypothesize that,

H_3: The changes in regulatory reforms after 2000-01 Dot Com Bubble Crash weakens the positive relation between CEO overconfidence and R&D; and further strengthen regulation after 2007-08 GFC shifts the CEO overconfidence and R&D relation to negative.

2.6 Board Overconfidence and Corporate Governance

Upper echelons theory suggests that strategic leaders; top management team and board of directors, affect organizational outcomes, particularly firm innovation (Hambrick and Mason, 1984), because they influence organizational attention, resource commitment, strategic choices, and implementation strategies (Carpenter et al., 2004; Gerstner et al., 2013; Kaplan, 2008a). Despite the acknowledgement that boards influence business strategy, Kurzhals et al. (2022) point out significant gaps in our understanding of the board's role in innovation (Carpenter et al., 2004; Pugliese et al., 2009). Moreover, scholars cannot generalize findings from literature regarding CEO-innovation association to board, as boards' functions, responsibilities, and agency differ consistently from those of CEOs (Finkelstein et al., 2009). To account for this gap, we investigate the influence of board of directors, particularly how an overconfident board responds to innovation and influences overconfident CEO and R&D association through different economic circumstances.

In this vein, researchers from a variety of fields have examined the connection between strategic leaders and innovation, including corporate governance (Rose et al., 2014), strategic management (Kor, 2006), finance (Ammann et al., 2016), and entrepreneurship (Gedajlovic et al., 2012); focusing on the need to consolidate the current body of knowledge. Ayyagari, et al. (2012) and Lee (2006) argue that firm innovation is also influenced by corporate governance. Firms with improved

governance utilise their resources more efficiently (Wang and Wang, 2015; Zelenyuk and Zheka, 2006). The board of directors have been enforced as the supreme legal authority for firms' decision making. According to the American Bar Association's Committee on Corporate Laws (1994), the board must evaluate and authorize essential operating, financial, corporate plans and strategies. Because of agency problems, managers' chosen projects do not always maximize shareholder value, hence directors need to withhold approval and insist on change. This active involvement in the firm's decision making is identified as the monitoring role of the board. Board of directors bring both human (experience, expertise, knowledge, skills and reputation) and social (information, power and community contacts) capital that has impact on strategic change and innovation (Letendre 2004; Nicholson and Kiel, 2004; Wu, 2008b; Subramaniam and Youndt, 2005; Hillman and Dalziel, 2003). One of the major human factors frequently suggested to affect innovation is leadership (King, 1990; Osborne, 1998; Shin and McClomb, 1998). Board members uses their knowledge, expertise, skills, and reputation to come up with new and innovative ideas and to secure resources needed for the implementation of innovations. They can promote organizational innovativeness by encouraging invention, setting goals and priorities for innovation, providing freedom to come up with new ideas and approving pioneering proposals (Daft, 1978). Kang et al. (2018) find firms with friendly board of directors achieve more patents and higher quality innovations. Boards contribute through authorising and overseeing the decisions (Fama and Jensen, 1983; Pugliese et al., 2009). This monitoring function exert an indirect effect on the outcome by influencing engagement of firms' resources (Ben Amar et al., 2013). Coles et al. (2014) find the firms generate more innovation when directors are friendly and cooperative. Manso (2011) document the positive association of innovation and encouraging board of directors. Faleye, et al. (2011) further confirms the role of supportive board in firm innovation as they argue that continuous monitoring by board directors reduces firms' innovation success. Despite the growing consensus, empirical literature on board is still limited (Ostrower and Stone, 2006), particularly an unexplored area is the mechanisms through which boards affect overconfident CEOs' innovation (Wu, 2008b). The empirical work on innovation has overlooked board issues (Markman et al., 2001; Miozzo and Dewick, 2002; O'Sullivan, 2000). Literature on boards focuses more on the nature of the board's activities and governance challenges but requires more evidence on boards influence

over firm decision. We examine how board overconfidence affects R&D and how it influences the relationship between CEO overconfidence and innovation during economic oscillations.

Board of directors are, if not the most significant, internal corporate governance mechanisms that supervises and counsels' management in carrying out the mandate to protect shareholder interests (Fama and Jensen, 1983; Hermalin and Weisbach, 2003; Adams and Ferreira, 2007; and Harris and Raviv, 2008). This role becomes especially important during periods of crises. For instance, Mace (1971) argues that, "directors serve as a source of advice and counsel, serve as some sort of discipline device, and act in crisis situations." Adding to this, Hermalin and Weisbach (1998) point out that in a booming economy, boards tend to be reactive because good firm performance increases CEOs' bargaining power and reduces board independence. In addition, board receive zero or less attention from investors when investment opportunities are plentiful (Mitton, 2002). However, during economic turmoil, boards become more proactive and independent as the bad firm performance reduces CEOs' negotiation power.

We hypothesize that with increased regulatory enforcements in the post-crash periods of 2000-01 and 2007-08, such as Sarbanes–Oxley Act of 2002, Emergency Economic Stabilization Act of 2008 and Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank), board interference will increase, and they will be unwilling towards granting too much R&D to condense firm risk. This might change the course of CEO overconfidence-R&D over this period of time. According to Hardy and Sever (2021), the effects of a banking crisis on firm innovation can be as long as 10 years or more. Hence we hypothesize that,

H_3: Due to regulatory reinforcement, overconfident board dominates overconfident CEOs in post dot com crash periods and reduces R&D investment, and they show a negative effect on R&D investment.

In this paper, we first examine how the relation between innovation and CEO overconfidence evolves from January 1993–December 2017 and two economic crisis during this time; the 2000-01 dot com bubble and 2007-08 financial crisis.

Overconfidence is measured following Galasso and Simcoe (2011) at 67% and we use Galasso and Simcoe (2011) at 100% and the method proposed by Malmendier and Tate (2005a, 2008) at 67% and 100% for robustness checks. Second, we investigate how the interplay between board overconfidence and economic crisis affects the interplay between the two.

3. Research Methodology

3.1. Data and Sample

Our analysis is based on a sample of CEOs and boards of directors of US publicly traded firms. We collect data on managerial compensation information from Standard and Poor's Execucomp. We obtain financial and accounting variables from Compustat and stock returns from the Center for Research in Security Prices (CRSP) database. We require non-missing data of CEO overconfidence measure (as described below) and all variables needed for the base specifications. Following previous studies (Galasso and Simcoe, 2011; Hirshleifer et al., 2012) we exclude financial firms and utilities. All financial and accounting variables are winsorised at 1% and 99% to eliminate the effects of outliers. We use quarterly data as we have precedence of it being used in the past for financial crisis analysis (Kahle and Stulz, 2013). This process yields a final sample of 5,779 CEOs, 38,304 Board members, 2,650 Firms and 1,18,189 firm-year observations between January 1993-December 2017.

To further investigate overconfidence and innovation during bullish vs bearish markets and its oscillations overtime, we divided the sample frame into five categories:

i) Dot com bubble (January 1993-March 2000)
ii) Dot com crash (April 2000 – September 2002)
iii) Post dot com crash (October 2002–September 2007)
iv) Global financial crisis (October 2007 – June 2009)
v) Post global financial crisis (July 2009-December 2017)

3.2. Identification Strategy

To measure the impact of CEO overconfidence on corporate innovation, we use the following model:

$$y_{i,t} = \alpha_1 + \alpha_2 OC_{i,t-1} + \beta' X_{i,t-1} + \gamma' Z_{i,t-1} + \nu_i + \mu_t + \varepsilon_{i,t} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where $y_{i,t}$ is firm *i*'s R&D expense over total assets in year *t*, $OC_{i,t-1}$ is a dummy variable that takes a value of 1 if firm *i* has an overconfident CEO in year *t-1* and 0 otherwise, $X_{i,t-1}$ is a vector of characteristics of firm *i* in year *t-1*, $Z_{i,t-1}$ is a vector of characteristics of the CEO of firm *i* in year *t-1*, ν_i and μ_t are industry and year fixed effects respectively, and $\varepsilon_{i,t}$ is the random error.

Panel data can be regressed using either pooled OLS, fixed effects model (FEM) or random effects model (REM). Selection of appropriate model depends on whether heterogeneity exists in the data and if that is correlated with the regressors. First, to decide whether heterogeneity correlated with explanatory variables exists, F-test is conducted on the dependent and independent variable. If the p-value of this regression is statistically significant, the null hypothesis of no heterogeneity across individuals can be rejected, implying that heterogeneity correlated with regressors exists. This will conclude that FEM is more appropriate than pooled OLS in the analysis. Then Breusch and Pagan Lagrangian multiplier test is used to test the existence of heterogeneity which is not correlated with regressors. If the p-value of the test is statistically significant, the null hypothesis of no heterogeneity can be rejected concluding that REM is more suitable than pooled OLS for the data. Finally, to decide between the suitability of FEM and REM, the Hausman test is conducted. Here, if the p-value is statistically significant, the null hypothesis of heterogeneity not correlated with regressors can be rejected concluding the suitability of FEM for the analysis. In this study sample, after running the F-test, Breusch-Pagan LM test and Hausman test, the fixed effects model (FEM) is found to be the most suitable method to estimate the model.

To eliminate omitted variable bias, we follow Hall and Ziedonis (2001), Glasso and Simmcoe (2011) and Hirshleifer et al. (2012) estimation of explanatory variables while regressing R&D expenditure. To address the endogeneity of overconfidence concern, we use four different methods of accessing overconfidence, namely Glasso

and Simmcoe (2011) at 67% and 100%, and Malmendier and Tate (2005a, 2008) at 67% and 100%. Each of these measures have shown consistent estimates for all models, eliminating endogeneity concern.

3.3. Variables

3.3.1. Dependent Variable

Following Hirshleifer et al. (2012), we measure innovation investment with R&D expenditures scaled by book assets and assign missing data for R&D expenditures a zero value. We do not analyse innovation success because data for patent counts and citations for the entire sample is not available.

3.3.2. Executives Overconfidence Measure

As part of executives' performance compensation, they are offered substantial stock option grants. During the 1990s, equity-based pay became popular in the United States. M.A. Klein, in his Top Executive Compensation: 1995 Edition, noted in a 1995 Conference Board Report that the median option grant is larger than the salary for CEOs in almost all US publicly traded corporations. Boards have been pressed by institutional investors, such as public pension funds, to provide CEOs equity pay. Activist shareholders also agreed on equity compensation as the best way to address the agency problem (Eisenhardt, 1989; Fama, 1980). According to agency theory, a conflict of interest between owners and managers may lead to managers making decisions that are not in the best interests of shareholders. Stock-based compensation is the most well-established approach for resolving this (Ellis, 1998; Kosnik, 1990). Managers are motivated to improve the value of the shares because they will be boosting their own wealth. Compensation was designed to encourage managers to take a more active role in the company. In 1989, the top 200 publicly traded companies in the United States set aside 7 percent of their common shares for executive compensation, rising to more than 13 percent in 1997. (Morgenson, 1998). According to the Investor Responsibility

Research Center (1997), director compensation has increased by 30 to 100 percent in recent years (Rose, 1997; Wall Street Journal, 1997).

Stock compensation has remained popular in the United States to this day. Because their personal wealth is linked to the company, it is thought that employees will aim to better companies' performance. These stock options have a time limit, and management can only exchange the shares when that time has passed. This makes executives portfolio highly undiversified and risky because they must hold stock options until the vesting period is over. Campbell et al. (2011) uses this idiosyncratic risk to measure executives overconfidence. Undiversified, rationally risk-averse executives will exercise their stock options as soon as the vesting period ends, and the price is high enough (Hall and Murphy, 2002). To back up this claim, Lambert, Larcker, and Verrecchia (1991) proposed a theoretical model in which risk-averse CEOs exercise in-the-money option grants before expiration to avoid idiosyncratic risk. Furthermore, Hall and Murphy (2002) establish a link between CEOs' financial situation, risk appetite, and level of diversification and the best exercise method for executive stock options. There is a chance of some CEOs to hold onto their stock options knowing the stock price will rise in the future due to them engaging in earnings' manipulation. However, researchers such as Campbell et al. (2011), Malmendier and Tate (2005, 2008), Galasso and Simcoe (2011) and Hirshleifer et al. (2012) have used executives stock option pattern to describe overconfidence, and since the measure is contingent upon holding at least 67% and twice during the tenure, the probability for earing manipulation is quite unlikely.

Existing literature also uses options exercising or trading behavior (Malmendier and Tate, 2005, 2008), language/tone (Davis et al., 2012) or media portrayal (Malmendier and Tate, 2008; Hirshleifer et al., 2012) to measure CEO overconfidence. In this paper, we use the stock options-based interpretation of CEO and executive overconfidence. Data for executive option exercising are available for whole period for both CEOs and other board executives. Following Galasso and Simcoe (2011), who argue that overconfidence is a permanent trait, we define an executive as overconfident for their entire tenure if they delay exercising stock options that are 67% in the money, i.e., if the stock price exceeds the exercise price by more than 67%, at least twice during their tenure. The decision to not exercise highly in-the-money exercisable options is an

indicator of executives confidence that the firms' stock prices will rise more in the future (Malmendier and Tate, 2005). We follow Campbell et al. (2011)'s method to calculate the average option moneyness as the realisable value per option divided by the average exercise price, where the realisable value per option is the total realisable value of the exercisable options (*opt_unex_exer_est_val*) divided by the number of exercisable options (*opt_unex_exer_num*), as shown in equation (i). The average exercise price is the difference between the realizable value per option and the stock price at the fiscal year end (*prccf*), as depicted in equation (ii). And lastly, the average moneyness, as illustrated in equation (iii), is the ratio between average realizable value and strike price. We define a board of directors as being overconfident if more than half of non-CEO executives are overconfident. In the robustness check, we measure executives overconfidence as Malmendier and Tate (2005, 2008). Theses authors classify an executive as overconfident from the first year in which they postpone exercisable in-the-money options. For board of directors robustness check, we classify a board as being overconfident if more than two-third of the non-CEO executives are overconfident. Under this method, a CEO can have overconfident board and non-overconfident board in different years. These various classifications yield similar results validating that our findings are conclusive.

$$\textbf{Average realizable value per option} = \frac{\textit{Total realizable value of the options}}{\textit{Number of options held}} \ldots\ \textbf{(i)}$$

$$\textbf{Strike price} = \textbf{Stock price} - \textbf{Average realizable value} \ldots\ \textbf{(ii)}$$

$$\textbf{Average moneyness} = \frac{\textit{Average realisable value}}{\textit{Strike price}} \ldots\ \textbf{(iii)}$$

3.3.3. Control Variables

We follow Hirshleifer et al. (2012) for including control variables like, firm size, profitability (Bah and Dumontier, 2001), capital intensity, growth opportunities, leverage (Singh and Faircloth, 2005), and free cash flow (Lewis and Tan, 2016).

i) Firm Size: Firm size is denoted either by total asset or sales of the firm. Aghion et al. (2009) suggests controlling for firm size while analyzing R&D expenditure. There are conflicting findings regarding the impact of firm size on R&D

spending. Larger firms have greater access to information and enjoy economies of scale. They often have greater capital to exploit innovative opportunities and initiate R&D programs (Hall and Ziedonis, 2001). On the other hand, executives in such firms may not receive many incentives for innovation as its impact will be very small compared to the firm size. Hence executives of such firms might be reluctant to invest or give efforts in R&D. Studies for instance, Graves, (1988) and Hansen and Hill (1991) find R&D expenditure to be negatively related to firm size. For this study, firm size is measured by the natural logarithm of sales. The functional change is made to correct for skewed distribution.

ii) Cash Flow: With developed and efficient capital market, firm investment does not depend on its internal cash flow. It can obtain financing from the market anytime for investments. However, capital market imposes some restriction on managers which limits their fund-raising capacity. Therefore, firm investment largely depends on availability of internal resources. Moreover, as overconfident executives think that market undermines their firm value, they are less inclined to issue stock to obtain financing for investment. This makes overconfident executives more sensitive to availability of internal funding. Therefore, it is expected to have a significant positive association between cash flow and R&D expenditure.

iii) Capital Intensity: Capital intensity reflects the amount of tangible assets per employee. This is a parameter to see how firm assets are distributed among employees and if they have enough infrastructure to carry out R&D strategies. Literatures, for instance, Aghion et al. (2009) and Hall and Ziedonis (2001) suggest controlling for capital-labor ratio while analyzing R&D spending. In this paper, we measured capital intensity as the natural logarithm of the ratio of net property, plant, and equipment to employees.

iv) Buy-and-hold abnormal returns (BHAR): Firms that overinvest in R&D reduces efficiency and firm value. Success of R&D projects are unpredictable, and this uncertainty increases firm risk and is reflected in higher stock return volatility. We measure stock returns by the Buy-and-hold return over the fiscal quarter.

v)Tobin's Q: Tobin's Q is the ratio of firms' market value of the asset to its book value, and it tells how market perceives the firm. A Tobin's Q more than 1 would

imply that market overvalues the firm, and the firm is likely to have good prospects. If the market overvalues a firm, the executive can easily obtain good amount of external financing for investing in R&D. Therefore, it is expected that firms high Tobin's Q should have a positive association with R&D spending.

vi) Sales Growth: Higher sales growth increase firm's profitability and it is viable for such firms to invest in long-term R&D projects. Cyert and March (1963) find a positive association with firm performance and R&D spending. For the analysis, sales growth is calculated by log transformation of sales divided by prior-quarter sales.

vi) Return on Asset: Return on asset indicates the profitability of the company relative to its asset, i.e., how efficient the management of company is. Since profits of R&D projects are realized after a long time, ROA is expected to have a negative association with it. Investment in R&D is made from present operating income which lowers the numerator of ROA, whereas the denominator remains constant. This reduces ROA for the year when there is an investment in R&D.

vii) Leverage: A higher amount of existing debt limits executives to make investments. This restriction increases when the investment is huge, involves uncertainty and is realized in the late future. Even if for a profitable levered firm, scope to invest in R&D is limited as the firm needs to fulfil its debt obligations first. High levered firms are considered risky by investors, and so managers in such firms restrain themselves from investing in R&D (Brown et al., 2009 and Faleye et al., 2011). Researchers document negative relation between leverage and R&D spending (Baysinger and Hoskisson, 1989). But for some studies, the association is found to be insignificant (Hitt et al., 1991). In this study, leverage is measured as the ratio of total debt to book value of assets.

We further control for CEO and Board specific characteristics to classify their influence of R&D expenditure.

viii) CEO Duality: This measure identifies if the CEO holds powerful position in the firm. CEO duality is a dummy variable which takes the value 1 when CEOs are assigned as chairperson/president, and 0 otherwise. This is the first study that analyses CEO power on innovation decision. Presence of CEO duality gives the CEO more

control and power over firms' decision and we expect this to have positive correlation with R&D expenditure.

ix) Board Size: Board size represents total number of directors on board for a firm year. Literature does not have any reference point on how board size impacts firm innovation. This gap in the research is addressed in this study.

x) Pay Inequality: This is the log transformation of ratio of CEOs salary to average board members salary. Salary is equal to total compensation, which is the summation of salary, bonus, total value of stock options granted (using Black-Scholes), total value of restricted stock grant, long-term incentive payouts and other annual compensation. Higher pay inequality would mean higher compensation for CEO compared to a board member, and this would substantially indicate dominance of CEOs over the board. We expect pay inequality to be positively related with R&D spending.

4. Results

Hirshleifer et al. (2012) established a link between CEO overconfidence and business R&D, however the analysis was limited to the year 2003 due to the lack of patent data from the NBER. Conversely, following the dot com bubble and 2007-08 financial crisis, CEO overconfidence and other variables impacting a firm's innovation have evolved, and no research has compared the link between CEO overconfidence and R&D spending. We use R&D expenditure to evaluate firm innovation and extend the analysis to address the variation over two independent global crisis. The descriptive statistics of firm R&D and other characteristics, and regression estimates are discussed in the following sections.

4.1. Frequency Distribution of CEO and Board Overconfidence

In Table 1, our sample distribution shows consistent proportion of overconfident CEOs and overconfident Board throughout sample periods. We observe the highest number of overconfident executives in post dot com crash period and lowest

in Post GFCperiod. Post dot com crash (October 2002–September 2007) was also the period when unrestrained optimism resulted in excessive expenditure. Everyone, including bankers and homeowners, thought the economy would continue to expand. This gave the appearance of safety to actions that were previously dangerous, such as aggressive leveraging and investment tactics and taking on excessive debt. A period of deregulation was also influenced by beliefs in economic growth, most notably through the repeal of the Glass-Steagall Act in 1999, an important piece of law from the Great Depression that distinguished between commercial and investment banking. The Glass-Steagall Act's major prohibitions were repealed, allowing banks and brokerages to grow considerably and paving the way for massive mergers. The Glass-Steagall Act reforms brought about an era of national development for companies. While this was one of the causes of the great recession, but it instigated managers to be confident in firms' prospect and thus we see a rise of overconfident executives during this time. After this period, we see a drop in the ratio of overconfident executives, marking the lowes in post GFC(July 2009-December 2017) period.

4.2. Descriptive Statistics

Tables 2 (panel I-VIII) and Tables 3 (panel I-VIII) demonstrate and compare the summary statistics of dependent and control variables for subsamples in different time periods. Consistent with literature, Table 1 Panel I show that overconfident CEOs, defined using unexercised 67% in-the-money stock options, are associated with higher R&D stock/Asset (%) in our entire period, while Table 2 Panel I shows quite the reverse; overconfident board spends less in R&D over asset compared to non-overconfident board. This novel finding explains the reduced R&D spending for overconfident CEOs in post-bubble period by linking overconfident board and increased corporate governance enforced by regulators. Another notable fact is, NASDAQ-listed firm shows more overall R&D expenditure for each category than NYSE firms. The Nasdaq is renowned for technology and innovation, and it is the location of cutting-edge businesses in the biotech, digital, and other industries. Technology firms (e.g., social media, internet of things, electric vehicles, artificial intelligence) have been at the forefront of this transition, but other industries have also advanced in reaction to demographics and expectations. Because of this, Nasdaq-listed

stocks are viewed as more growth-oriented and volatile. Companies that list on the NYSE, on the other hand, are seen as being more reliable and well-established. Blue chips and industrials, some of which have been in operation for centuries, are attracted to the NYSE. Due to these characteristics, we see higher innovation expenditure for NASDAQ-listed firms.

In Table 2 and Table 3, we divide the whole period into five sub periods to account for 2000-01 dot com bubble and 2007-08 financial crisis years. We first conduct the analysis for *full sample (January 1993-December 2017),* followed by subsample analysis of *Dot com bubble (January 1993- March 2000), Dot com crash (April 2000 – September 2002), Post dot com crash (October 2002–September 2007), Global financial crisis (October 2007 – June 2009)* and *post global financial crisis (July 2009- December 2017).*

Table 2 shows that overconfident CEOs invest significantly more in R&D up until the dot com crash (September 2002). Starting from post dot com crash (October 2002) till end of global financial crisis (GFC) (June 2009) Panel IV- V finds a slim increase in R&D investment of their counterparts. However during the post GFC period, overconfident CEOs seems to regain their investment back to higher than non-overconfident counterparts. And as predicted from our literature review above, Nasdaq-listed firms shows significantly more R&D investment (almost 2.5 times) for each group than NYS firms but shows consistent pattern with overconfident CEOs investing more than others.

For board of directors, Table 3 shows lowers R&D investments for overconfident Board, except for the Dot com bubble (January 1993- March 2000). Following the pattern, Nasdaq-listed firms show more R&D expenditure and maintain lower investment for overconfident boards. The preliminary results in Table 1 and Table 2 show that the relationship between CEO overconfidence and R&D investment shifts during economic turmoil, and that board overconfidence could be an influencing governance component for this change. We take the investigation further and analyse firm R&D expenditure while controlling for variables and outline how firms investment pattern changes during industry fluctuations when administered by overconfident CEOs/Board.

[Table 1, 2 and 3 here]

4.2. Regression Estimates

The dot-com bubble had a very detremental effect on the economy. It caused a slight recession and damaged trust in the fledgling internet business. Even bigger and more prosperous businesses suffered as a result of how far it had progressed. Several businesses filed for bankruptcy when the dot-com bubble broke. One illustration is WorldCom, which acknowledged to making accounting errors of billions of dollars, causing a sharp decline in the value of its stock. Savings decreased as investment spending rose, while household borrowing rose. These savings were so small that they weren't enough to pay for the cost of the manufacturing elements needed to cover initial investment requirements.

Further following the 2007-08 financial crisis, banks restricted loans and concentrated on protecting claims on borrowers rather than encouraging to engage in value-adding activities. Firms, too, saw substantial reorganization in terms of personnel turnover and investment cuts. Particularly, it was extremely challenging for firms to access credit lines and access external capital due to the extreme market conditions marked by liquidity shortfalls (Ivashina & Scharfstein, 2010), uncertainty, and financial institutions' conservative approach, which called for more internal control. Firms also experienced a variety of exogenously-driven constraints such as low product demand, which hurt their ability to internally produce adequate resources to finance lucrative investments. This raises the question of whether the previously observed positive relationship between CEO overconfidence and R&D spending persists after the crisis. R&D is one of the major big investments for firms and it is very likely to be affected by the credit crunch in the economy. We extend the existing findings by providing empirical evidence of how financial crisis interacts with strengthened corporate governance and influence overconfident CEOs' investment decision in innovation.

4.2.1. CEO Overconfidence and R&D

We hypothesize that association between R&D investment and overconfident CEOs change in the wake of 2000-01 dot com crash and 2007-08 financial crisis. We explore the link in Table 4-6 where we use R&D scaled by total assets as the dependent variable and CEO overconfidence is calculated following Galasso and Simcoe (2011). The robustness checks using Galasso and Simcoe (2011) at 100%, Malmendier and Tate (2005) at 67% and 100% are depicted in Appendix I(C) Table 15. Our base model contains all applicable firm characteristics recommended by the literature (mentioned above). In the following analysis (Table 5), we additionally incorporate managerial and board controls; CEO duality, Board size and Pay inequality to analyse overconfident CEOs precise influence on R&D expenditure. In Table 6, we separately run all sub-sample analysis for NYSE and NASDAQ-listed firms. In all regression analysis, standard errors are clustered at firm level to control for the correlation of residuals within executives-firm pairs (Petersen, 2009). We also incorporate year and industry fixed effects to control for unobserved heterogeneity across firms over time.

[Table 4-6 here]

Table 4-6 depicts the moving association between CEO overconfidence and R&D expenditure during various economic periods. As per past literature (e.g., Hirshleifer et al. (2012), Malmendier and Tate (2005)), we would expect overconfident CEOs to invest more under any circumstances. However, we discover positive R&D investment for overconfident CEOs only during the dot com bubble, and its gradually became insignificant and eventually turning into negative association in post dot com crash period and onwards. We explain this change due to increased regulatory reinforcement placed after the dot com crash, for instance the initiation of Sarbanes–Oxley Act of 2002, Emergency Economic Stabilization Act of 2008, Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank), which forces board intervention or corporate decisions, and as a result lowers risky investments like R&D. Such interventions, as we predict, will be more so on overconfident CEOs due to their pre-established risk-taking nature. None of the previous work has shown this dynamic variation, and our research contributes to this comprehensive disclosure.

In Table 4, we run our primary analysis by regressing CEO overconfidence and other influencing control variables of innovation against R&D expenditure. The coefficient in column (2) reveals that an overconfident CEO invests 33.30 percent more in R&D/assets. Using its ratio to the mean R&D/Assets for non-overconfident CEOs (0.575), we find that overconfidence boosts R&D expenditure by 57.91 percent. However, following the bubble crash, column (3) indicates that this link becomes insignificant. Also in column 1, we find that the previously observed substantial positive connection between CEO overconfidence and R&D investment no longer exists for the whole sample. Our findings for the CEO overconfidence measure using Galasso and Simcoe (2011) at 100%, Malmendier and Tate (2005) at 67% and 100% depicted in Appendix I(C) Table 15 are robust for each sample. We argue that the reversed link between R&D and overconfident CEOs following the dot com crash was due to increased corporate governance placed on firms, as argued above, which was further strengthen during GFC making the association negative.

We find R&D expenditure to be adversely linked with company size, cash, stock returns, ROA and leverage, which is consistent with Hirshleifer et al. (2012). Capital intensity and Tobin's Q are both positively connected to R&D. Firms with a higher Tobin's Q have more market possibilities, while firms with higher capital intensity have the freedom to explore innovative options. These findings are in line with Galasso and Simcoe (2011).

Table 5 controls for CEO duality, board size, and pay inequality to validate if the findings in Table 4 are robust for CEO and Board characteristics. We label CEO duality equals to 1 if the CEO is also the chairman/president of the board in that firm-quarter. Table 5 gives us consistence result for all sample periods; however, we see a significant positive R&D expenditure in full sample period after controlling for board independence (CEO duality), board size and CEO power (pay inequality). CEO duality does not show any significant influence over R&D spending, however we get an important exposure towards the significance of board size. Higher board size decreases R&D spending in post GFC period. Having higher directors on board increases the monitoring and governance pressure, specifically on overconfident CEOs, and this results in their significant lower investment in R&D. Pay inequality, represented as CEO power, also shows significant positive association with R&D, and as we can

predict there impact on R&D spending increases in post GFC period. Having higher CEO power represents week governance and board monitoring, and we find board size and pay inequality to depict opposite association with R&D spending. Pay inequality also displays significant positive R&D in overall and dot com bubble period, concluding CEO power to greatly dominate investment during this period.

Table 6 shows the analysis for all periods separately for NYSE and NASDAQ-listed firms. NASDAQ firms shows 5-10 times more R&D for overconfident CEOs regardless of the period. As we know from NASDAQ listed firms nature, they are tech heavy and thus more likely more to invest in innovation. The technology focus of the index is certainly a factor. While NYSE firms never displays positive association with R&D, NASDAQ firms have consistently maintained a positive relation, with most significant in dot com bubble period. This is because of the nature of NASDAQ firms capitalizing on the internet boom of dot com bubble, which resulted in their increase in R&D; more so with an overconfident CEO. But following the GFC, both NYSE and NASDAQ firms shows negative R&D investments.

4.2.2. Board of Directors: Influence on the Dot Com Crash, GFC and R&D Expenditure

Due to rising demand and a lack of reliable valuation methodologies, the majority of IT and internet companies that launched IPOs during the dotcom era were grossly overvalued. High multipliers were applied to the valuations of tech companies, producing overly optimistic and unrealistic prices. Analysts' attention was diverted from these companies' core analyses, and their capacity for generating income was disregarded in favor of meaningless website traffic measurements. By examining their P/E ratios, research was conducted and found that more than 40% of dotcom companies were overvalued. Business magazines, like The Wall Street Journal, Forbes, Bloomberg, and numerous publications that analyse investments, stoked demand through their media channels, adding fuel to a fire that was already burning and expanding the bubble. The momentum for technical innovation and buoyancy began in December 1996 with a lecture by Alan Greenspan on "irrational exuberance." Abundant

venture capital along with accounting misconduct fuelled the bubble resting into burst in early 2000.

Firms negligent monitoring was highly criticised during this time following Enron and WorldCom scandal. Officers and workers of Enron engaged in numerous fraudulent accounting practices as well as other offenses. They stole money from the company, falsified the company's results in financial reports to shareholders, and illegally manipulated the energy markets, forging power shortages to raise electricity prices. The business covered up its financial losses and reported profits on assets that were actually losing money. Jeffrey Skilling, the former CEO of Enron, was released from a federal prison in 2018 after serving the longest sentence of the numerous business executives who were imprisoned for their roles in the scam. Former Enron Chairman Kenneth Lay, who passed away in 2006 after being found guilty of the crimes, and former Enron CFO Andrew Fastow, who was freed from federal prison in 2008, were two other executives accused in the crimes. After being implicated in Enron's misdeeds, Arthur Andersen's Houston office, which had certified the company's false financial reports, lost the majority of its clientele. Enron filed for bankruptcy shortly after its stock price crashed in the summer of 2001 as a result of its inability to conceal its debt.

In order to increase its stated earnings on its profit and loss accounts, WorldCom started doing so in 2001. It accomplished this by falsifying financial information in its annual reports, Form 10-K filings, income statements and balance sheets. At the time of the affair, Scott Sullivan, WorldCom's CFO, utilized unethical strategies to divide billions of dollars in operational expenses among many property accounts, which are a type of capital expense account. Due to the years-long extension of expenses, the business was able to inflate its revenue by over $3 billion in 2001 and post a $1.4 billion profit as opposed to a loss. The WorldCom fraud was initially discovered through internal audits. Internal auditors Cynthia Cooper and her group found suspicious entries made by WorldCom's wireless division. The business ultimately declared bankruptcy, costing its shareholders billions. Both these scandals pressured firms to strengthen their internal governance and include external monitoring over firm financials.

Shortly after, the Financial Crisis Inquiry Commission (FCIC) (2011) identified failures of corporate governance and risk management as the key causes of the 2008 financial crisis. The catastrophe might have been prevented if corporate governance and oversight had been robust enough. Following the 2007-08 financial crisis, the preservation of shareholder money became a higher priority. For overconfident CEOs, increased corporate governance has had an impact on post-crisis R&D investment. And it is highly likely that Overconfident CEOs encountered more scrutiny because of their established high risk-taking behaviour. Increased internal corporate governance and monitoring of board could be a reason why overconfident CEOs no longer make more R&D investment.

In Table 7-10, we assess R&D investment pattern of the overconfident board. CEOs are excluded while constructing board overconfident measure. For each board executives, overconfidence is calculated similarly as CEOs. In a year, the board is considered overconfident if more than half (method 1) or two-third (method 2) of board executives are overconfident. Under this measure, a CEO can have overconfident board or non-overconfident board in different quarters. Contrasting to overconfident CEOs, an overconfident board invest less in R&D. As Hernández et al. (2010) highlighted the power conflict in board room between directors who hold large percentage of equity (more power) and directors with less or none (less power); powerful directors could be especially hesitant to engage in decisions on risky investments in innovation, favoring short-term investments that could result in more stock options for themselves (Jensen & Meckling, 1976). Since Overconfident board are the ones who prefers to hold their stock options longer, they are likely to display negligence to risky investments such as R&D. The stewardship theory, which contends that directors are reluctant to take on greater risk as their equity increases, is consistent with our findings (Hernández et al., 2010). If such investments fail, directors' reputations and even their careers might be at stake. This is demonstrated in the empirical evidence obtained by Herrmann et al. (2010), Cebula & Rossi (2015), and Rossi & Cebula (2015) that provide negative results for this association.

We also find directors spending on R&D significantly decreases in following post dot com crash periods. We presume that due to increased scrutiny and corporate governance, the role of board of directors in the firm became more dominant and they

over-power the CEOs after 2000-01 bubble crash. This new profound dominance of board reduces R&D, and the previous literature findings of "Overconfident CEOs equals more R&D" does not prevail any longer. The overconfident board triumphs over the CEO's overconfidence and drastically reduces the firm's R&D investment, more significantly after the dot com crash.

[Insert Table 7-10 here]

Table 8 illustrates the association between board overconfidence and R&D expenditure over different time periods for NYSE and NASDAQ-listed firms. Overconfident Board shows consistent negative association towards R&D for both NYSE and NASDAQ firms. The response is more towards NASDAQ-listed firms as they are more tech heavy and usually have more R&D spending then NYSE firms. Overconfident board's significant negative response towards NASDAQ firms R&D strengthens further from after Dot Com Crash periods. As pointed by Sierra-Morán et al. (2021) and Hoskisson et al. (2002), our results confirm overconfident board reluctant towards R&D spending and supports our hypothesis that increased board dominance in post-crash period may be responsible for negative CEO overconfidence-R&D association in that period. The overconfident board adjusting for R&D expense after the crash highlights the way to monitor CEOs and strengthen scrutiny.

For robustness check, we use two variations to measure Board overconfidence. Method 1 (Table 7 and 8), where the board is considered overconfident in a year if more than half of board members are overconfident. Table 9 and 10 labels Board as overconfident if more than two-third (method 2) of board members are overconfident in that year. Also, we investigate the difference in NYSE and NASDAQ exchange firms and find board dominance to be significantly more in NASDAQ, reducing R&D expenditure for firms where the board is overconfident.

4.2.3. CEO Overconfidence and R&D: Analysis With CEO and Board Overconfidence

In Table 11 and 12, we analyse CEO overconfidence and R&D separately when the board is overconfident or non-overconfident. We observe that the power of CEO overconfidence is more with non-overconfident board and CEO overconfidence-R&D association turns more negative for overconfidence board following the dot com crash. This transition of power dominance from overconfident CEOs to overconfident board is new-found in the literature. Overconfident CEOs invest relatively less in R&D under the oversight of an overconfident board. Furthermore, after the crash, the influence of an overconfident board is stronger, compelling CEOs to drop R&D expenditure. Our findings offer a strong assessment on how the economic crisis interacted with corporate governance, impacting CEOs' R&D decisions. Table 11 panel II, offers the exchange specific analysis, and our results show similar dominance of overconfidence board after the dot com crash.

Table 11 (Method 2: More than Two-third), however, do not show very likely results, but given the unbalanced sample size, the results is not comprehensive. Table 11 panel II presents exchange wise analysis, but due to unbalanced sample size, the result is not conclusive.

In general, the results supports our prediction that CEOs have the upper hand when the board is not overconfident, but the power dynamics shifts when the board is overconfident. This enormity increases more during the post-crash period, highlighting the increased control of overconfident board during this era.

5. Alternative Explanation: Impact of Financial Constraints

Internal cashflow is an important determinant of R&D investment for both high-tech firms (Himmelberg and Petersen, 1994) and manufacturing firms (Bougheas et al., 2003). Bond et al. (2003) used panel data of manufacturing companies in Belgium, France, Germany, and UK to analyse the role of financial constraints on investment decisions and they find cash flow and profits to be statistically significant for UK firms. Savignac (2008) finds that firms are 20 percent less likely to innovate under financial constraint. Cincera and Ravet (2010) find R&D investment is sensitive to cash flow only for EU firms.

Duchin et al. (2010) reports the effect of subprime mortgage credit crisis on corporate investment by assessing investments in 2007-08 pre- and post-crisis periods. They find that financially constrained firms with low cash reserves or dependent on external finance are affected the most by this crisis. Jeong (2015) extends the model of Duchin et al. (2010) to Korean corporate investments. Jeong uses lagged cash reserves to remove the endogeneity that might occur between past cash reserves and investment and finds a significant decline in R&D after the financial crisis and strong influence of the availability of external finance. Campello et al. (2010) address financial constraints issue by surveying 1,050 CFOs and asking if firms were credit constrained during the financial crisis of 2008. The survey validates that the financial constraints after the crisis negatively affected planned investment. Campello et al. (2009) find firms in post-crisis, regardless location, uses liquid cash for daily operations or short-term liquidity needs. In addition, 13% of constrained U.S. firms confirmed they reserve more cash now than before as their credit line has been cut off. All these studies indicate a potential influence of financial constraints for lower R&D after the crisis in our study.

In our sample, if firms with overconfident CEOs happen to be those with server financial constraints after the crisis, then insignificant or negative relationship between CEO overconfidence and R&D expenditure could be because of short of cash flow rather than the strengthened corporate governance from the overconfident board. To examine this alternative explanation, we conduct more analysis of financial constraints in Table 13.

[Insert Table 13 here]

Based on free cash, leverage, size, and the Kaplan-Zingales index, we classify firms into high financially constrained and low constrained groups in Table 13. The median is used as the cut-off for each metric. Firms with low cash, high debt, smaller size, and a low KZ index are more financially constrained, and we would anticipate them to invest considerably less in R&D as a result. The coefficients of CEO overconfidence with respect to R&D are not significant for any periods. Estimations in Table 13 do not provide support to the argument that financial constraints are the cause for reduced R&D in post-crash period. As a result, we rule out financial constraints as a cause of post-crash R&D investment declines and confirm that the decrease is attributable to enhanced corporate governance. The detailed results are shown in Appendix I(C) Table 16 panel I- XXIV.

6. Conclusions

We investigate the impact of two major economic crisis in the US economy; the 2000-01 dot com bubble and 2007-08 financial crisis, on overconfident CEOs' innovation decisions. Overconfident CEOs are known to be more innovative, but following the dot com bubble, with the awake of stringent governance policy, we see a shift. This economic downturn shifted decision-making authority away from CEOs and onto board directors, and we can see this dominance for innovation strategy. Overconfident boards indicate a reluctance to spend on R&D, which increases dramatically following dot com bubble, further after the 2007-08 crisis. Overconfident CEOs in the pre-crash period invest more in R&D due to their sheer nature and dominance. The board, on the other hand, suppresses the CEOs in the post-crash period, and firms' R&D expenditure drops.

We use Galasso and Simcoe (2011) to measure overconfidence and use Malmendier and Tate (2005) for robustness checks. The R&D/Asset ratio is used to account for innovation costs. Sales, capital intensity, Tobin's Q, leverage, and cash are

elements of control variables in R&D. The sample years are separated into five sub periods, full sample (January 1993-December 2017), Dot com bubble (January 1993-March 2000), Dot com crash (April 2000 – September 2002) , Post dot com crash (October 2002–September 2007), Global financial crisis (October 2007 – June 2009) and Post global financial crisis (July 2009- December 2017).We control for CEO duality, board size, and pay inequality to further investigate the CEO and board characteristics. If the CEO is also the chairman or president of the company, we label CEO duality equal 1, or 0 otherwise. Board size shows significant negative correlation in post GFC period, indicating higher influence of board over R&D decisions. We broaden the scope of the study to include board overconfidence to explain its influence on firm innovation. According to studies (Jaskyte, 2009; Wu and Lee, 2007), the board of directors can impact organizational innovation, and we analyse the interplay between board of directors' overconfidence and economic crisis to explain the shift in the CEO overconfidence-innovation association.

Ours is the first study to document the impact of both 2000-01 dot com crisis and 2007-08 credit crisis on the overconfidence-innovation relationship. We fill the literature gaps with empirical evidence of the dynamics through time, and we conclude that corporate governance has become more dominant due to regulatory enforcements. With empirical support, we rule out financial constraints as a factor influencing this relationship. When setting policies, business and policymakers will need to consider the rising power of board directors over CEOs. Our findings suggest that companies may experience increased agency costs in the future, hence organizational precautionary steps are recommended. Academic researchers, on the other hand, will have to take board power into account when studying business strategies. Unlike before, the strategic change within firms no longer solely depends on CEOs.

7. References

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8. Tables

Table 1: Frequency Distribution of Overconfident CEOs and Board of Directors Over Sample Periods

The table gives the sample wise overview of total observation of CEOs, frequency of overconfident CEOs, total observation of Boards and frequency of Overconfident Boards. in the sample. Data of CEOs is from Execucomp. Financial and utility firms are excluded from analysis. The final sample is formed by the interaction of firms in Execucomp, Compustat and CRSP. Firm identifier (GVKEY) is used to merge the datasets. The options-based measure of CEO overconfidence defines a CEO as overconfident after he holds options that are at least 67% in-the-money stock options atleast twice during their tenure.

Sample Frame	*Total CEOs*	*Overconfident CEOs*	*Overconfident CEOs (%)*	*Total Board*	*Overconfident Board*	*Overconfident Board (%)*
Full Sample (January 1993-December 2017)	118,189	85,374	72.24%	118,074	24,762	20.97%
Dot com bubble (January 1993-March 2000)	29,613	20,775	70.15%	29,600	5,989	20.23%
Dot com crash (April 2000-September 2002)	11,357	8,730	76.87%	11,354	2,419	21.31%
Post dot com crash (October 2002–September 2007)	24,377	19,136	78.50%	24,375	5,874	24.10%
Global financial crisis (October 2007–June 2009)	9,482	6,946	73.25%	9,474	2,060	21.74%
Post global financial crisis (July 2009-December 2017)	43,360	29,787	68.70%	43,271	8,420	19.46%

Table 2: CEO Sub-sample Summary Statistics

The table lists means, medians and standard deviations of the variables in different sample periods examined in this study. The sample consists of all non-financial and non-utility firms. The final sample is formed by the interaction of Execucomp, Compustat and CRSP. Firm identifier (GVKEY) is used to merge the datasets. The options-based measure defines an executive as overconfident if he/she holds options that are at least 67% in-the-money stock options at least twice during the tenure, and 0 otherwise.

Panel I: Overall sample (January 1993-December 2017)

Overall sample (1993-2017)								
	Non-overconfident CEO (N= 32,815)			*Overconfident CEO (N= 85,374)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
R&D/Asset (%)	0.791	0.000	1.575	0.976	0.000	1.704	-0.185***	0.000***
Sales	1209.922	291.246	2823.692	1124.771	292.702	2644.666	85.151***	-1.456***
Cash	-0.002	0.000	0.063	0.003	0.000	0.066	-0.005***	0.000***
PPE/EMP	193.730	40.462	684.318	191.314	37.538	717.725	2.416**	2.924***
BHAR	-0.011	0.002	0.222	0.013	0.028	0.226	-0.024**	-0.026***
Tobin's Q	1.899	1.480	1.320	2.225	1.753	1.485	-0.326***	-0.273***
Sales growth	0.013	0.015	0.204	0.027	0.028	0.200	-0.014***	-0.013***
ROA	0.031	0.031	0.033	0.037	0.037	0.031	-0.006***	-0.006***
Book leverage	0.224	0.207	0.190	0.214	0.198	0.183	0.010***	0.009***

Panel II: Dot com bubble (January 1993- March 2000)

Dot com bubble (January 1993- March 2000)								
	Non-overconfident CEO (N= 8,838)			*Overconfident CEO (N= 20,775)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
R&D/Asset (%)	0.575	0.000	1.362	1.055	0.000	1.889	-0.480***	0.000***
Sales	678.656	227.652	1382.966	844.991	207.762	2096.332	-166.335***	19.890***
Cash	-0.001	0.000	0.058	0.003	0.000	0.064	-0.004***	0.000***
PPE/EMP	115.874	35.725	334.747	116.084	32.641	378.006	-0.210***	3.084***

BHAR	-0.017	0.000	0.212	0.009	0.024	0.235	-0.026***	-0.024***
Tobin's Q	1.951	1.461	1.416	2.327	1.785	1.610	-0.376***	-0.324***
Sales growth	0.023	0.025	0.215	0.039	0.038	0.219	-0.016***	-0.013***
ROA	0.037	0.036	0.032	0.042	0.042	0.032	-0.005***	-0.006***
Book leverage	0.224	0.218	0.172	0.220	0.205	0.174	0.004***	0.013***

Panel III: Dot com crash (April 2000 – September 2002)

Dot com crash (March 2000 – September 2002)								
	Non-overconfident CEO (N= 2,627)			*Overconfident CEO (N= 8,730)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
R&D/Asset (%)	0.831	0.000	1.595	0.973	0.000	1.668	-0.142***	0.000***
Sales	1017.954	267.561	2124.617	882.763	231.711	2122.428	135.191***	35.850***
Cash	-0.002	0.000	0.067	0.006	0.001	0.067	-0.008***	-0.001***
PPE/EMP	107.824	38.092	401.944	145.003	36.441	503.122	-37.179**	1.651***
BHAR	-0.032	0.000	0.276	-0.002	0.011	0.284	-0.030***	-0.011***
Tobin's Q	1.986	1.343	1.726	2.432	1.767	1.890	-0.446***	-0.424***
Sales growth	0.003	0.011	0.226	0.019	0.022	0.221	-0.016***	-0.011***
ROA	0.028	0.029	0.033	0.037	0.037	0.033	-0.009***	-0.008***
Book leverage	0.236	0.241	0.192	0.223	0.216	0.185	0.013***	0.025***

Panel IV: Post dot com crash (October 2002 – September 2007)

Post dot com crash (October 2002 – September 2007)								
	Non-overconfident CEO (N=5,241)			*Overconfident CEO (N=19,136)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
R&D/Asset (%)	0.945	0.000	1.590	0.907	0.000	1.542	0.038***	0.000***
Sales	1193.877	260.844	2692.734	1091.967	297.300	2518.272	101.910***	-36.456***
Cash	-0.003	0.000	0.065	0.004	0.001	0.066	-0.007***	-0.001***

PPE/EMP	102.382	36.748	399.441	177.049	36.462	665.524	-74.667***	0.286***
BHAR	0.004	0.014	0.217	0.023	0.036	0.206	-0.019**	-0.022***
Tobin's Q	1.956	1.567	1.218	2.178	1.774	1.324	-0.222***	-0.207***
Sales growth	0.019	0.019	0.199	0.034	0.032	0.187	-0.015***	-0.013***
ROA	0.028	0.029	0.032	0.037	0.036	0.029	-0.009***	-0.007***
Book leverage	0.202	0.188	0.180	0.194	0.180	0.174	0.008***	0.008***

Panel V: Global financial crisis (October 2007 – June 2009)

Global financial crisis (October 2007 – June,2009)

	Non-overconfident CEO (N=2,536)			*Overconfident CEO (N=6,946)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
R&D/Asset (%)	1.066	0.000	1.880	0.989	0.000	1.716	0.077***	0.000***
Sales	1250.788	237.138	3016.359	1157.624	305.225	2714.437	93.164***	-68.087***
Cash	0.000	0.000	0.071	0.005	0.001	0.072	-0.005***	-0.001***
PPE/EMP	162.723	40.202	634.601	258.800	40.644	925.047	-96.077**	-0.442***
BHAR	-0.126	-0.103	0.252	-0.104	-0.072	0.255	-0.022***	-0.031**
Tobin's Q	1.744	1.398	1.194	1.966	1.595	1.251	-0.222***	-0.197***
Sales growth	-0.009	0.000	0.221	-0.005	0.010	0.211	-0.004***	-0.010***
ROA	0.027	0.029	0.038	0.033	0.034	0.034	-0.006***	-0.005***
Book leverage	0.196	0.162	0.192	0.210	0.189	0.186	-0.014**	-0.027***

Panel VI: Post global financial crisis (July 2009- December 2017)

Post global financial crisis (July 2009- December 2017)

	Non-overconfident CEO (N= 13,573)			*Overconfident CEO (N= 29,787)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
R&D/Asset (%)	0.814	0.000	1.614	0.963	0.000	1.671	-0.149***	0.000***
Sales	1591.569	372.903	3510.394	1404.246	404.767	3117.549	187.323***	-31.864***

Cash	-0.003	-0.001	0.062	0.001	0.000	0.065	-0.004***	-0.001***
PPE/EMP	302.117	47.316	933.087	250.782	41.742	899.592	51.335***	5.574***
BHAR	0.014	0.021	0.204	0.040	0.046	0.194	-0.026***	-0.025***
Tobin's Q	1.855	1.494	1.218	2.183	1.752	1.390	-0.328***	-0.258***
Sales growth	0.010	0.011	0.190	0.023	0.024	0.185	-0.013***	-0.013***
ROA	0.030	0.030	0.032	0.035	0.034	0.030	-0.005***	-0.004***
Book leverage	0.235	0.209	0.204	0.221	0.202	0.191	0.014***	0.007***

Panel VII: Overall sample (1993-2017) NYS Exchange

Overall sample (1993-2017) NYS Exchange								
	Non-overconfident CEO (N= 16,999)			*Overconfident CEO (N= 47,148*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
R&D/Asset (%)	0.410	0.000	0.989	0.461	0.000	0.985	-0.051***	0.000***
Sales	1722.264	532.668	3338.693	1599.775	521.458	3193.342	122.489***	11.210***
Cash	-0.002	0.000	0.047	0.001	0.000	0.050	-0.003***	0.000***
PPE/EMP	275.603	55.080	836.893	236.761	43.376	791.208	38.842***	11.704***
BHAR	-0.005	0.008	0.195	0.014	0.031	0.204	-0.019***	-0.023***
Tobin's Q	1.760	1.448	1.050	1.994	1.652	1.186	-0.234***	-0.204***
Sales growth	0.011	0.013	0.177	0.022	0.023	0.180	-0.011***	-0.010***
ROA	0.036	0.033	0.025	0.040	0.038	0.025	-0.004***	-0.005***
Book leverage	0.259	0.254	0.173	0.253	0.241	0.169	0.006***	0.013***

Panel VIII: Overall sample (1993-2017) NAS Exchange

Overall sample (1993-2017) NAS Exchange								
	Non-overconfident CEO (N= 11,565)			*Overconfident CEO (N= 32,444)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
R&D/Asset (%)	1.424	0.320	1.971	1.743	1.111	2.130	-0.319***	-0.791***

Sales	698.135	153.475	2178.479	548.742	128.760	1612.981	149.393***	24.715***
Cash	0.001	0.000	0.076	0.006	0.002	0.081	-0.005***	-0.002***
PPE/EMP	98.766	32.051	426.798	110.797	32.014	513.930	-12.031**	0.037***
BHAR	-0.006	0.004	0.238	0.014	0.028	0.246	-0.02***	-0.024**
Tobin's Q	2.197	1.672	1.602	2.599	2.033	1.771	-0.402***	-0.361***
Sales growth	0.018	0.019	0.208	0.033	0.035	0.215	-0.015***	-0.016***
ROA	0.029	0.030	0.037	0.034	0.035	0.037	-0.005***	-0.005***
Book leverage	0.160	0.090	0.192	0.155	0.086	0.183	0.005***	0.004***

Table 3: Board of Directors Sub-sample Summary Statistics

The tables lists means, medians and standard deviations of the variables in different sample periods examined in this study. The sample consists of all non-financial and non-utility firms. The final sample is formed by the interaction of Execucomp, Compustat and CRSP. Firm identifier (GVKEY) is used to merge the datasets. The options-based measure defines an executive as overconfident if he/she holds options that are at least 67% in-the-money stock options at least twice during the tenure, and 0 otherwise. CEOs are excluded from the sample. A Board is considered overconfident if more than half (50%) or two-third (75%) identifies as overconfident. Overconfident Board is a dummy variable equal to 1 if the board displays overconfidence and 0 if the board is non-overconfident.

Panel I: Overall sample (1993-2017)

Overall sample (1993-2017)

	Non-overconfident Board (N=69,402)			*Overconfident Board (N= 48,672)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Mean*
R&D/Asset (%)	0.943	0.000	1.724	0.919	0.000	1.691	0.024***	0.000***
Sales	1177.208	300.500	2655.122	1100.612	284.499	2697.456	76.596***	16.001***
Cash	-0.001	0.000	0.064	0.005	0.001	0.065	-0.006***	-0.001***
PPE/EMP	182.545	39.070	658.186	200.239	36.908	737.318	-17.694***	2.162***
BHAR	-0.003	0.011	0.226	0.019	0.036	0.223	-0.022***	-0.025***
Tobin's Q	1.918	1.524	1.280	2.442	1.922	1.606	-0.524***	-0.398***
Sales growth	0.016	0.019	0.205	0.032	0.032	0.196	-0.016***	-0.013***
ROA	0.032	0.032	0.032	0.041	0.040	0.031	-0.009***	-0.008***
Book leverage	0.224	0.212	0.185	0.206	0.185	0.184	0.018***	0.027***

Panel II: Dot com bubble (January 1993- March 2000)

Dot com bubble (January 1993- March 2000)

Non-overconfident Board (N= 17,698	*Overconfident Board (N=11,902)*	*Difference*

	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Mean*
R&D/Asset (%)	0.856	0.000	1.731	1.018	0.000	1.904	-0.162***	0.000***
Sales	817.369	233.263	1821.628	762.396	190.757	2015.385	54.973***	42.506***
Cash	0.000	0.000	0.061	0.004	0.000	0.064	-0.004***	0.000***
PPE/EMP	119.014	34.633	338.900	111.404	31.812	398.817	7.610***	2.821***
BHAR	-0.008	0.002	0.223	0.014	0.032	0.237	-0.022***	-0.030***
Tobin's Q	1.997	1.529	1.398	2.532	1.962	1.720	-0.535***	-0.433***
Sales growth	0.027	0.027	0.220	0.045	0.044	0.214	-0.018***	-0.017***
ROA	0.038	0.037	0.031	0.045	0.045	0.032	-0.007***	-0.008***
Book leverage	0.232	0.229	0.172	0.205	0.182	0.175	0.027***	0.047***

Panel III: Dot com crash (March 2000 – September 2002)

Dot com crash (March 2000 – September 2002)

	Non-overconfident Board (N= 6,478			*Overconfident Board (N=4,876)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Mean*
R&D/Asset (%)	1.003	0.000	1.745	0.868	0.000	1.592	0.135***	0.000***
Sales	936.194	251.489	2019.388	883.441	228.493	2228.475	52.753***	22.996***
Cash	0.002	0.000	0.069	0.007	0.001	0.065	-0.005***	-0.001***
PPE/EMP	106.878	37.725	373.977	174.418	35.267	582.217	-67.540***	2.458***
BHAR	-0.022	0.000	0.288	0.008	0.021	0.274	-0.030***	-0.021***
Tobin's Q	2.088	1.457	1.725	2.647	1.937	1.986	-0.559***	-0.480***
Sales growth	0.007	0.013	0.228	0.027	0.030	0.213	-0.020***	-0.017***
ROA	0.029	0.031	0.034	0.042	0.041	0.031	-0.013***	-0.010***

Book leverage	0.231	0.234	0.187	0.218	0.205	0.186	0.013***	0.029***

Panel IV: Post dot com crash (October 2002 – September 2007)

Post dot com crash (October 2002 – September 2007)

	Non-overconfident Board (N= 13,276			*Overconfident Board (N=11,099)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Mean*
R&D/Asset (%)	1.023	0.000	1.653	0.798	0.000	1.478	0.225***	0.000
Sales	1154.806	287.027	2491.764	1060.224	292.783	2592.254	94.582***	-5.756***
Cash	-0.001	0.000	0.066	0.006	0.002	0.065	-0.007***	-0.002***
PPE/EMP	111.061	36.924	416.312	218.162	35.882	774.906	-107.101***	1.042***
BHAR	0.012	0.021	0.214	0.028	0.041	0.202	-0.016***	-0.020
Tobin's Q	1.913	1.583	1.125	2.390	1.940	1.450	-0.477***	-0.357***
Sales growth	0.024	0.024	0.197	0.039	0.036	0.181	-0.015***	-0.012***
ROA	0.029	0.029	0.030	0.043	0.041	0.029	-0.014***	-0.012***
Book leverage	0.204	0.192	0.175	0.187	0.168	0.175	0.017***	0.024***

Panel V: Global financial crisis (October 2007 – June 2009)

Global financial crisis (October 2007 – June 2009)

	Non-overconfident Board (N= 5,440			*Overconfident Board (N=4,034)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Mean*
R&D/Asset (%)	1.073	0.000	1.880	0.948	0.000	1.714	0.125***	0.000***
Sales	1210.697	285.231	2753.856	1139.530	288.954	2809.074	71.167***	-3.723***
Cash	0.002	0.000	0.073	0.007	0.002	0.070	-0.005***	-0.002***
PPE/EMP	185.926	41.164	701.850	288.036	39.894	984.012	-102.110***	1.270***

BHAR	-0.122	-0.091	0.252	-0.094	-0.061	0.257	-0.028***	-0.030***
Tobin's Q	1.735	1.419	1.078	2.138	1.724	1.397	-0.403***	-0.305***
Sales growth	-0.011	0.003	0.219	-0.001	0.014	0.205	-0.010***	-0.011***
ROA	0.028	0.030	0.035	0.036	0.038	0.035	-0.008***	-0.008***
Book leverage	0.208	0.184	0.189	0.203	0.182	0.185	0.005***	0.002***

Panel VI: Post global financial crisis (July 2009- December 2017)

Post global financial crisis (July 2009- December 2017)

	Non-overconfident Board (N= 26,510			*Overconfident Board (N=16,761)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Mean*
R&D/Asset (%)	0.918	0.000	1.711	0.936	0.000	1.680	-0.018***	0.000***
Sales	1480.499	390.500	3222.462	1421.103	401.247	3201.850	59.396***	-10.747***
Cash	-0.003	-0.001	0.063	0.003	0.001	0.065	-0.006***	-0.002***
PPE/EMP	278.554	44.923	905.300	237.834	41.299	852.809	40.720***	3.624
BHAR	0.022	0.029	0.202	0.048	0.053	0.188	-0.026***	-0.024***
Tobin's Q	1.864	1.526	1.169	2.425	1.934	1.528	-0.561***	-0.408***
Sales growth	0.013	0.015	0.188	0.028	0.027	0.184	-0.015***	-0.012***
ROA	0.030	0.030	0.030	0.038	0.037	0.031	-0.008***	-0.007***
Book leverage	0.231	0.211	0.196	0.216	0.195	0.194	0.015***	0.016***

Panel VII: Overall sample (1993-2017) NYS Exchange

Overall sample (1993-2017) NYS Exchange

	Non-overconfident Board (N= 37,412			*Overconfident Board (N=26,707)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Mean*

R&D/Asset (%)	0.446	0.000	1.009	0.451	0.000	0.979	-0.005***	0.000***
Sales	1658.217	563.250	3102.361	1585.603	482.691	3336.010	72.614***	80.559***
Cash	-0.001	0.000	0.049	0.002	0.001	0.050	-0.003***	-0.001***
PPE/EMP	244.799	48.997	771.482	243.524	42.311	804.605	1.275***	6.686***
BHAR	0.001	0.016	0.201	0.019	0.037	0.203	-0.018***	-0.021***
Tobin's Q	1.777	1.484	1.023	2.150	1.772	1.290	-0.373***	-0.288***
Sales growth	0.014	0.016	0.180	0.027	0.027	0.178	-0.013***	-0.011***
ROA	0.036	0.034	0.024	0.043	0.041	0.025	-0.007***	-0.007***
Book leverage	0.259	0.252	0.168	0.248	0.233	0.172	0.011***	0.019***

Panel VIII: Overall sample (1993-2017) NAS Exchange

Overall sample (1993-2017) NAS Exchange

	Non-overconfident Board (N= 24,869			*Overconfident Board (N=19,054)*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Mean*
R&D/Asset (%)	1.735	1.081	2.155	1.598	0.769	2.144	0.137***	0.312***
Sales	622.334	133.798	1964.261	538.014	138.574	1473.308	84.32***	-4.776***
Cash	0.002	0.000	0.080	0.009	0.003	0.080	-0.007***	-0.003***
PPE/EMP	102.941	32.054	465.377	111.442	31.949	499.528	-8.501***	0.105***
BHAR	0.000	0.010	0.245	0.021	0.035	0.242	-0.021***	-0.025***
Tobin's Q	2.203	1.711	1.552	2.869	2.295	1.881	-0.666***	-0.584***
Sales growth	0.021	0.024	0.215	0.039	0.039	0.210	-0.018***	-0.015***
ROA	0.028	0.029	0.036	0.039	0.040	0.037	-0.011***	-0.011***
Book leverage	0.163	0.099	0.188	0.146	0.069	0.182	0.017***	0.03***

Table 4: CEO Overconfidence and R&D/Asset (%)

The table presents regression estimates of R&D/Asset on CEO overconfidence. The dependent variable is the ratio of R&D expenditure to total asset. Missing values of R&D are replaced with 0. A CEO is considered overconfident if he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years (Galasso and Simcoe, 2011). CEO displays overconfidence if he displayed overconfidence at least twice during the tenure, and 0 otherwise. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. Variable definitions are provided in the Appendix I (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
	Full sample (January 1993-December 2017)	*Dot com bubble (January 1993-March 2000)*	*Dot com crash (April 2000-September 2002)*	*Post dot com crash (October 2002-September 2007*	*Global financial crisis (October 2007-June 2009)*	*Post global financial crisis (July 2009-December 2017)*
CEO_GS67	0.064	0.333***	0.092	-0.017	-0.114	-0.063
	(1.61)	(5.80)	(1.17)	(-0.27)	(-1.18)	(-0.99)
Log(sale)	-0.265***	-0.258***	-0.290***	-0.241***	-0.300***	-0.245***
	(-8.98)	(-6.82)	(-5.15)	(-6.26)	(-6.53)	(-6.15)
Cash	-0.024*	-0.008	-0.041	0.011	-0.061	-0.025
	(-1.77)	(-0.26)	(-1.32)	(0.43)	(-1.52)	(-1.24)
Log (PPE/E)	0.032	0.146***	0.130**	0.127***	-0.077	-0.018
	(0.96)	(2.82)	(2.44)	(3.05)	(-1.34)	(-0.41)
BHAR	-0.056***	-0.063***	-0.061***	-0.029**	-0.064***	-0.075***
	(-8.89)	(-4.61)	(-4.75)	(-2.42)	(-2.74)	(-5.72)
Tobin's Q	0.656***	0.528***	0.489***	0.679***	0.802***	0.809***
	(15.82)	(8.78)	(8.49)	(9.82)	(8.55)	(10.92)
Sales growth	0.138***	0.119***	0.069**	0.143***	0.260***	0.152***
	(10.47)	(6.09)	(2.39)	(6.75)	(5.01)	(7.24)
ROA	-0.717***	-0.668***	-0.589***	-0.707***	-0.924***	-0.807***
	(-13.86)	(-7.90)	(-6.55)	(-8.27)	(-9.33)	(-10.12)
Book leverage	-0.112***	-0.287***	-0.081	-0.036	-0.082	-0.083**
	(-3.80)	(-8.48)	(-1.40)	(-0.90)	(-1.32)	(-1.98)
Constant	1.161***	1.129***	0.675***	1.350***	0.959**	1.268***
	(4.16)	(3.45)	(3.60)	(3.79)	(2.27)	(2.70)

Observations	118,189	29,613	11,357	24,377	9,482	43,360
Adjusted R^2	0.351	0.324	0.353	0.358	0.379	0.393

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: CEO Overconfidence and R&D/Asset (%) with Control Variables (Galasso and Simcoe, 2011)

The table demonstrates the results of regressions of R&D/Asset on CEO overconfidence with Board specific control variables. A CEO is considered overconfident if he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years if he displayed overconfidence at least twice during the tenure, and 0 otherwise. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
	Full sample (January 1993-December 2017)	*Dot com bubble (January 1993-March 2000)*	*Dot com crash (April 2000-September 2002)*	*Post dot com crash (October 2002-September 2007)*	*Global financial crisis (October 2007-June 2009)*	*Post global financial crisis (July 2009-December 2017)*
CEO_GS67	0.071*	0.343***	0.101	-0.026	-0.097	-0.049
	(1.77)	(5.92)	(1.26)	(-0.39)	(-1.15)	(-0.76)
CEO duality	-0.013	0.081	-0.104	-0.033	-0.031	-0.018
	(-0.37)	(1.16)	(-1.19)	(-0.49)	(-0.49)	(-0.35)
Board Size	-0.058**	-0.097	-0.044	0.038	-0.027	-0.120***
	(-1.99)	(-1.57)	(-0.76)	(0.78)	(-0.51)	(-2.74)
Log (pay inequality)	0.048***	0.154***	0.013	-0.035	0.005	0.051**
	(2.74)	(5.69)	(0.22)	(-1.09)	(0.15)	(1.97)
Log(sale)	-0.270***	-0.284***	-0.288***	-0.238***	-0.279***	-0.256***
	(-8.96)	(-7.28)	(-5.10)	(-6.16)	(-5.62)	(-6.26)
Cash	-0.023*	-0.002	-0.039	-0.007	-0.027	-0.024
	(-1.65)	(-0.06)	(-1.22)	(-0.27)	(-0.69)	(-1.20)
Log (PPE/E)	0.041	0.163***	0.130**	0.142***	-0.019	-0.023
	(1.23)	(3.35)	(2.40)	(3.35)	(-0.34)	(-0.55)
BHAR	-0.053***	-0.059***	-0.062***	-0.030**	-0.045**	-0.073***
	(-8.37)	(-4.12)	(-4.78)	(-2.46)	(-2.24)	(-5.59)

Tobin's Q	0.655***	0.544***	0.490***	0.667***	0.754***	0.808***
	(15.21)	(9.00)	(8.24)	(8.74)	(7.11)	(10.95)
Sales growth	0.136***	0.131***	0.072**	0.140***	0.202***	0.153***
	(10.88)	(6.43)	(2.39)	(5.95)	(6.87)	(7.25)
ROA	-0.693***	-0.663***	-0.585***	-0.681***	-0.734***	-0.805***
	(-13.20)	(-7.46)	(-6.19)	(-7.00)	(-9.32)	(-10.15)
Book leverage	-0.106***	-0.289***	-0.079	-0.024	-0.040	-0.084**
	(-3.50)	(-8.23)	(-1.37)	(-0.58)	(-0.56)	(-2.02)
Constant	1.149***	0.786**	0.636	1.548***	1.053**	1.010**
	(3.89)	(2.18)	(1.57)	(3.77)	(2.32)	(2.05)
Observations	114,118	27,498	11,110	23,629	8,521	43,360
Adjusted R^2	0.350	0.334	0.350	0.344	0.352	0.394

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: CEO Overconfidence and R&D/Asset (%) for NYSE and NASDAQ-listed firms (Galasso and Simcoe, 2011)

The table demonstrates the results of regressions of R&D/Asset on CEO overconfidence for NYSE and NASDAQ-listed firms separately for each sample period. A CEO is considered overconfident if he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years if he displayed overconfidence at least twice during the tenure, and 0 otherwise. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable = R&D/Total Assets (%)												
Galasso and Simcoe (2011)												
	Full sample (January 1993-December 2017)		*Dot com bubble (January 1993-March 2000)*		*Dot com crash (April 2000-September 2002)*		*Post dot com crash (October 2002-September 2007)*		*Global financial crisis (October 2007-June 2009)*		*Post global financial crisis (July 2009-December 2017)*	
	NYS	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*
OC_GS67	-0.019	0.086	0.050	0.910***	-0.003	0.153	-0.058	0.095	-0.111*	-0.173	-0.055	-0.162
	(-0.59)	(0.97)	(1.13)	(5.24)	(-0.06)	(0.94)	(-0.83)	(0.98)	(-1.68)	(-1.05)	(-1.10)	(-1.30)
Log(sale)	0.018	-0.200***	0.063*	-0.179*	0.079**	-0.163*	0.033	-0.177**	-0.001	-0.197**	-0.034	-0.164**
	(0.68)	(-3.27)	(1.93)	(-1.85)	(2.52)	(-1.78)	(1.10)	(-2.35)	(-0.03)	(-2.20)	(-0.94)	(-2.16)
Cash	0.014	-0.037*	0.031	-0.050	0.004	-0.031	-0.020	0.066**	0.088**	-0.126**	0.015	-0.035
	(1.53)	(-1.88)	(1.38)	(-1.00)	(0.17)	(-1.08)	(-1.01)	(2.16)	(2.03)	(-2.56)	(1.28)	(-1.20)
Log (PPE/E)	0.044*	0.074	0.033	0.320**	0.066*	0.143	0.072**	0.110	0.020	-0.069	0.038	0.048
	(1.74)	(1.07)	(0.85)	(2.11)	(1.81)	(1.16)	(2.10)	(1.33)	(0.56)	(-0.66)	(1.35)	(0.59)
BHAR	-0.038***	-0.044***	-0.042***	-0.028	-0.052***	-0.014	-0.021**	-0.033	-0.019	-0.053	-0.050***	-0.087***
	(-7.93)	(-3.80)	(-3.55)	(-1.11)	(-5.22)	(-0.69)	(-2.03)	(-1.53)	(-1.48)	(-1.58)	(-6.45)	(-3.68)
Tobin's Q	0.303***	0.618***	0.278***	0.278***	0.252***	0.317***	0.343***	0.575***	0.277***	0.781***	0.334***	0.895***
	(8.71)	(11.71)	(4.73)	(4.06)	(6.66)	(6.00)	(4.90)	(7.05)	(3.49)	(7.13)	(6.87)	(10.28)
Sales growth	0.013	0.121***	-0.000	0.073**	-0.040***	0.016	0.016	0.109***	0.018	0.236***	0.036***	0.171***

	(1.61)	(5.87)	(-0.02)	(2.19)	(-3.76)	(0.39)	(1.37)	(4.26)	(1.22)	(4.75)	(2.64)	(4.72)
ROA	-0.117***	-0.821***	-0.081	-0.602***	-0.058*	-0.359***	-0.126***	-0.698***	-0.122***	-1.067***	-0.175***	-1.034***
	(-4.60)	(-12.45)	(-1.61)	(-4.68)	(-1.72)	(-4.45)	(-3.20)	(-8.53)	(-3.16)	(-10.25)	(-4.14)	(-10.64)
Book leverage	-0.103***	-0.031	-0.149***	-0.386***	-0.115***	-0.045	-0.102***	0.102	-0.069**	-0.017	-0.093***	0.015
	(-5.60)	(-0.50)	(-4.91)	(-4.97)	(-3.13)	(-0.57)	(-3.21)	(1.47)	(-2.32)	(-0.15)	(-3.24)	(0.18)
Constant	1.199***	1.524**	1.294***	1.338	0.743***	0.080	1.063**	1.880***	0.650*	1.767***	0.754*	0.895***
	(4.02)	(2.11)	(2.88)	(0.95)	(3.18)	(0.31)	(2.53)	(7.15)	(1.68)	(4.19)	(1.82)	(3.81)
Observations	64,147	44,009	17,344	7,960	6,224	3,786	13,002	9,317	4,735	4,220	22,842	18,726
Adjusted R^2	0.209	0.375	0.203	0.345	0.273	0.308	0.233	0.372	0.189	0.464	0.227	0.431

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Board Overconfidence and R&D/Asset (%)

The table presents the results of regressions of R&D/Asset on Board overconfidence. The dependent variable is the ratio of R&D expenditure to total asset. Missing values of R&D are replaced with 0. CEOs are excluded from the sample. A Board is considered overconfident if more than half (50%) holds options that are at least 67% in the money. Overconfident Board is a dummy variable equal to 1 if the board displays overconfidence and 0 if the board is non-overconfident. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. Variable definitions are provided in the Appendix I (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

Method 1: More than half

	Dependent Variable = R&D/Total Assets (%) Galasso and Simcoe (2011)					
	Full sample (January 1993-December 2017)	*Dot com bubble (January 1993-March 2000)*	*Dot com crash (April 2000-September 2002)*	*Post dot com crash (October 2002-September 2007*	*Global financial crisis (October 2007-June 2009)*	*Post global financial crisis (July 2009-December 2017)*
Board Overconfidence	-0.087**	-0.025	-0.089	-0.111**	-0.149**	-0.143**
	(-2.32)	(-0.38)	(-1.21)	(-2.22)	(-2.09)	(-2.38)
Log(sale)	-0.265***	-0.257***	-0.294***	-0.244***	-0.302***	-0.246***
	(-9.00)	(-6.70)	(-5.21)	(-6.36)	(-6.52)	(-6.14)
Cash	-0.023*	-0.007	-0.041	0.013	-0.063	-0.023
	(-1.71)	(-0.23)	(-1.32)	(0.47)	(-1.59)	(-1.13)
Log (PPE/E)	0.031	0.135***	0.126**	0.127***	-0.078	-0.020
	(0.91)	(2.58)	(2.38)	(3.07)	(-1.37)	(-0.46)
BHAR	-0.054***	-0.058***	-0.060***	-0.029**	-0.066***	-0.074***
	(-8.48)	(-4.25)	(-4.63)	(-2.35)	(-2.79)	(-5.59)
Tobin's Q	0.666***	0.544***	0.496***	0.687***	0.810***	0.823***
	(16.09)	(8.83)	(8.72)	(9.98)	(8.65)	(11.06)
Sales growth	0.139***	0.121***	0.068**	0.143***	0.261***	0.154***
	(10.53)	(6.12)	(2.34)	(6.71)	(4.98)	(7.38)
ROA	-0.711***	-0.659***	-0.580***	-0.698***	-0.916***	-0.806***
	(-13.70)	(-7.76)	(-6.37)	(-8.03)	(-9.21)	(-10.14)
Book leverage	-0.113***	-0.278***	-0.080	-0.037	-0.083	-0.085**
	(-3.82)	(-8.14)	(-1.39)	(-0.94)	(-1.34)	(-2.02)

Constant	1.215***	1.300***	0.740***	1.063***	0.943**	0.870*
	(4.22)	(4.09)	(3.91)	(2.86)	(2.19)	(1.89)
Observations	118,074	29,600	11,354	24,375	9,474	43,271
Adjusted R^2	0.351	0.320	0.353	0.359	0.378	0.393

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Board Overconfidence and R&D/Asset (%) for NYSE and NASDAQ-listed firms (Galasso and Simcoe, 2011)

The table presents the results of regressions of R&D/Asset on Board overconfidence. The dependent variable is the ratio of R&D expenditure to total asset. Missing values of R&D are replaced with 0. CEOs are excluded from the sample. A Board is considered overconfident if more than half (50%) holds options that are at least 67% in the money. Overconfident Board is a dummy variable equal to 1 if the board displays overconfidence and 0 if the board is non-overconfident. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. Variable definitions are provided in the Appendix I (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

Method 1: More than half

	Dependent Variable = R&D/Total Assets (%) Galasso and Simcoe (2011)											
	Full sample (January 1993-December 2017)		*Dot com bubble (January 1993-March 2000)*		*Dot com crash (April 2000-September 2002)*		*Post dot com crash (October 2002-September 2007)*		*Global financial crisis (October 2007-June 2009)*		*Post global financial crisis (July 2009-December 2017)*	
	NYS	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*
Board Overconfidence	-0.043	-0.210***	-0.037	-0.065	0.021	-0.271**	-0.067	-0.170*	-0.071	-0.359***	-0.050	-0.339***
	(-1.59)	(-2.78)	(-0.82)	(-0.38)	(0.44)	(-2.10)	(-1.57)	(-1.83)	(-1.30)	(-2.73)	(-1.43)	(-2.91)
Log(sale)	0.017	-0.204***	0.061*	-0.195*	0.081**	-0.168*	0.031	-0.181**	-0.001	-0.205**	-0.033	-0.170**
	(0.64)	(-3.33)	(1.85)	(-1.76)	(2.53)	(-1.83)	(1.04)	(-2.40)	(-0.03)	(-2.27)	(-0.94)	(-2.23)
Cash	0.015	-0.036*	0.032	-0.054	0.004	-0.030	-0.019	0.069**	0.087**	-0.127***	0.015	-0.031
	(1.57)	(-1.82)	(1.39)	(-1.08)	(0.17)	(-1.04)	(-0.99)	(2.24)	(2.01)	(-2.63)	(1.32)	(-1.06)
Log (PPE/E)	0.042*	0.073	0.028	0.339**	0.067*	0.149	0.071**	0.111	0.019	-0.075	0.036	0.047
	(1.70)	(1.05)	(0.74)	(2.05)	(1.82)	(1.19)	(2.09)	(1.34)	(0.53)	(-0.72)	(1.28)	(0.57)
BHAR	-0.038***	-0.042***	-0.041***	-0.016	-0.052***	-0.013	-0.021**	-0.031	-0.019	-0.056*	-0.050***	-0.084***
	(-7.84)	(-3.56)	(-3.42)	(-0.62)	(-5.29)	(-0.63)	(-2.09)	(-1.48)	(-1.50)	(-1.70)	(-6.45)	(-3.50)

Tobin's Q	0.306***	0.637***	0.282***	0.297***	0.251***	0.331***	0.346***	0.591***	0.280***	0.810***	0.337***	0.923***
	(8.70)	(12.10)	(4.79)	(3.95)	(6.55)	(6.35)	(4.93)	(7.37)	(3.50)	(7.44)	(6.86)	(10.56)
Sales growth	0.013	0.122***	0.001	0.073**	-0.040***	0.012	0.016	0.108***	0.019	0.236***	0.037***	0.174***
	(1.61)	(5.97)	(0.04)	(2.13)	(-3.79)	(0.30)	(1.33)	(4.20)	(1.24)	(4.78)	(2.64)	(4.86)
ROA	-0.115***	-0.809***	-0.079	-0.587***	-0.060*	-0.341***	-0.122***	-0.679***	-0.122***	-1.052***	-0.175***	-1.029***
	(-4.53)	(-12.26)	(-1.56)	(-4.41)	(-1.75)	(-4.17)	(-3.12)	(-8.08)	(-3.24)	(-10.12)	(-4.13)	(-10.68)
Book leverage	-0.103***	-0.033	-0.148***	-0.352***	-0.115***	-0.040	-0.103***	0.101	-0.071**	-0.016	-0.092***	0.010
	(-5.62)	(-0.54)	(-4.88)	(-4.30)	(-3.13)	(-0.51)	(-3.25)	(1.44)	(-2.37)	(-0.14)	(-3.22)	(0.12)
Constant	1.196***	1.612**	1.321***	1.935*	0.738***	0.896***	1.059**	1.842***	0.607	1.620***	0.724*	0.446**
	(4.00)	(2.32)	(2.92)	(1.75)	(3.18)	(3.85)	(2.56)	(6.86)	(1.59)	(4.71)	(1.76)	(2.37)
Observations	64,119	43,923	17,344	7,948	6,224	3,783	13,000	9,317	4,729	4,218	22,822	18,657
Adjusted R^2	0.210	0.376	0.203	0.331	0.273	0.310	0.233	0.373	0.188	0.464	0.226	0.434

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Board Overconfidence and R&D/Asset (%)

The table presents the results of regressions of R&D/Asset on Board overconfidence. The dependent variable is the ratio of R&D expenditure to total asset. Missing values of R&D are replaced with 0. CEOs are excluded from the sample. A Board is considered overconfident if more than two-third (75%) holds options that are at least 67% in the money. Overconfident Board is a dummy variable equal to 1 if the board displays overconfidence and 0 if the board is non-overconfidence. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. Variable definitions are provided in the Appendix I (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

Method 2: More than 2/3

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
	Full sample (January 1993-December 2017)	*Dot com bubble (January 1993-March 2000)*	*Dot com crash (April 2000-September 2002);*	*Post dot com crash (October 2002-September 2007*	*Global financial crisis (October 2007-June 2009);*	*Post global financial crisis (July 2009-December 2017)*
Board Overconfidence	-0.090**	-0.153**	-0.168**	-0.062	-0.053	-0.118*
	(-2.33)	(-2.23)	(-2.40)	(-1.07)	(-0.68)	(-1.84)
Log(sale)	-0.265***	-0.258***	-0.296***	-0.243***	-0.300***	-0.246***
	(-9.00)	(-6.70)	(-5.20)	(-6.31)	(-6.49)	(-6.16)
Cash	-0.024*	-0.006	-0.041	0.012	-0.064	-0.024
	(-1.72)	(-0.22)	(-1.32)	(0.44)	(-1.60)	(-1.16)
Log (PPE/E)	0.031	0.133**	0.126**	0.126***	-0.077	-0.020
	(0.91)	(2.54)	(2.38)	(3.04)	(-1.35)	(-0.45)
BHAR	-0.055***	-0.057***	-0.059***	-0.029**	-0.066***	-0.075***
	(-8.53)	(-4.17)	(-4.62)	(-2.40)	(-2.82)	(-5.69)
Tobin's Q	0.664***	0.547***	0.496***	0.681***	0.800***	0.817***
	(16.03)	(8.97)	(8.57)	(9.92)	(8.57)	(10.99)
Sales growth	0.139***	0.121***	0.068**	0.143***	0.261***	0.154***
	(10.53)	(6.13)	(2.35)	(6.74)	(4.98)	(7.36)
ROA	-0.712***	-0.655***	-0.577***	-0.704***	-0.920***	-0.808***
	(-13.75)	(-7.75)	(-6.51)	(-8.11)	(-9.21)	(-10.16)
Book leverage	-0.113***	-0.281***	-0.084	-0.037	-0.085	-0.085**
	(-3.84)	(-8.22)	(-1.46)	(-0.92)	(-1.37)	(-2.03)

Constant	1.201***	1.300***	0.735***	1.019***	0.897**	0.852*
	(4.22)	(4.11)	(3.90)	(2.90)	(2.22)	(1.86)
Observations	118,074	29,600	11,354	24,375	9,474	43,271
Adjusted R^2	0.351	0.321	0.353	0.359	0.377	0.393

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Board Overconfidence and R&D/Asset (%) for NYSE and NASDAQ-listed firms (Galasso and Simcoe, 2011)

The table presents the results of regressions of R&D/Asset on Board overconfidence. The dependent variable is the ratio of R&D expenditure to total asset. Missing values of R&D are replaced with 0. CEOs are excluded from the sample. A Board is considered overconfident if more than two-third (75%) holds options that are at least 67% in the money. Overconfident Board is a dummy variable equal to 1 if the board displays overconfidence and 0 if the board is non-overconfidence. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. Variable definitions are provided in the Appendix I (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

Method 2: More than two-third

	Dependent Variable = R&D/Total Assets (%) Galasso and Simcoe (2011)											
	Full sample (January 1993-December 2017)		*Dot com bubble (January 1993-March 2000)*		*Dot com crash (April 2000-September 2002)*		*Post dot com crash (October 2002-September 2007)*		*Global financial crisis (October 2007-June 2009)*		*Post global financial crisis (July 2009-December 2017)*	
	NYS	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*
Board Overconfidence	-0.023	-0.188**	-0.040	-0.280*	0.018	-0.213	-0.028	-0.079	0.013	-0.201	-0.034	-0.276**
	(-0.79)	(-2.44)	(-0.72)	(-1.79)	(0.35)	(-1.33)	(-0.59)	(-0.68)	(0.24)	(-1.38)	(-0.95)	(-2.28)
Log(sale)	0.017	-0.204***	0.062*	-0.190*	0.080**	-0.176*	0.033	-0.180**	-0.000	-0.195**	-0.034	-0.169**
	(0.66)	(-3.33)	(1.86)	(-1.72)	(2.53)	(-1.92)	(1.10)	(-2.38)	(-0.01)	(-2.18)	(-0.95)	(-2.21)
Cash	0.014	-0.037*	0.032	-0.057	0.004	-0.030	-0.020	0.068**	0.087**	-0.128***	0.014	-0.032
	(1.53)	(-1.84)	(1.40)	(-1.14)	(0.17)	(-1.05)	(-1.01)	(2.21)	(2.02)	(-2.63)	(1.26)	(-1.09)
Log (PPE/E)	0.043*	0.070	0.029	0.346**	0.066*	0.150	0.072**	0.108	0.020	-0.072	0.037	0.042
	(1.74)	(1.00)	(0.75)	(2.07)	(1.82)	(1.20)	(2.09)	(1.30)	(0.56)	(-0.70)	(1.32)	(0.52)
BHAR	-0.038***	-0.043***	-0.041***	-0.015	-0.053***	-0.012	-0.022**	-0.032	-0.021	-0.055*	-0.051***	-0.087***
	(-7.86)	(-3.60)	(-3.43)	(-0.59)	(-5.28)	(-0.60)	(-2.16)	(-1.48)	(-1.60)	(-1.66)	(-6.47)	(-3.63)

Tobin's Q	0.304***	0.632***	0.281***	0.307***	0.252***	0.328***	0.343***	0.582***	0.274***	0.789***	0.334***	0.909***
	(8.70)	(12.03)	(4.80)	(4.15)	(6.58)	(6.25)	(4.90)	(7.29)	(3.44)	(7.25)	(6.85)	(10.50)
Sales growth	0.013	0.122***	0.001	0.073**	-0.040***	0.014	0.016	0.109***	0.020	0.236***	0.036***	0.173***
	(1.61)	(5.96)	(0.04)	(2.11)	(-3.78)	(0.33)	(1.35)	(4.24)	(1.33)	(4.76)	(2.63)	(4.82)
ROA	-0.117***	-0.812***	-0.080	-0.581***	-0.059*	-0.345***	-0.126***	-0.690***	-0.127***	-1.058***	-0.176***	-1.032***
	(-4.58)	(-12.32)	(-1.58)	(-4.38)	(-1.74)	(-4.23)	(-3.17)	(-8.24)	(-3.38)	(-10.12)	(-4.14)	(-10.66)
Book leverage	-0.103***	-0.034	-0.148***	-0.357***	-0.114***	-0.044	-0.103***	0.103	-0.071**	-0.023	-0.093***	0.010
	(-5.63)	(-0.55)	(-4.87)	(-4.35)	(-3.10)	(-0.56)	(-3.23)	(1.46)	(-2.36)	(-0.21)	(-3.23)	(0.12)
Constant	1.189***	1.591**	1.316***	1.953*	0.740***	0.616***	1.031**	1.865***	0.572	1.623***	0.716*	0.454**
	(4.01)	(2.29)	(2.93)	(1.76)	(3.17)	(3.36)	(2.55)	(6.94)	(1.58)	(4.68)	(1.74)	(2.41)
Observations	64,119	43,923	17,344	7,948	6,224	3,783	13,000	9,317	4,729	4,218	22,822	18,657
Adjusted R^2	0.209	0.375	0.203	0.332	0.273	0.309	0.233	0.372	0.187	0.461	0.226	0.432

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: CEO Overconfidence and R&D/Asset when The Board is Overconfident/Non-overconfident (Galasso and Simcoe, 2011)

Panel I: Method 1 (More than Half)

The table lists the results of regressions of R&D/Asset on CEO overconfidence when board is overconfident and when board is non-overconfident. CEOs were excluded while constructing board overconfidence measure. The board if considered overconfident in a year if more than half (method 1) of board members are overconfident. Under this measure, a CEO can have either overconfidence board or non-overconfidence board in different years of his/her tenure. *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%) Galasso and Simcoe (2011)											
	Full sample (January 1993-December 2017)		*Dot com bubble (January 1993-March 2000)*		*Dot com crash (April 2000-September 2002)*		*Post dot com crash (October 2002-September 2007)*		*Global financial crisis (October 2007-June 2009)*		*Post global financial crisis (July 2009-December 2017)*	
	Non-OC Board	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*
OC-_GS67	0.100**	0.093	0.374***	0.361***	0.113	0.183	-0.003	0.034	-0.109	0.040	0.000	-0.120
	(2.20)	(1.09)	(5.48)	(3.83)	(1.23)	(1.04)	(-0.04)	(0.28)	(-0.93)	(0.24)	(0.00)	(-0.76)
Log(sale)	-0.275***	-0.244***	-0.222***	-0.317***	-0.301***	-0.285***	-0.252***	-0.209***	-0.346***	-0.261***	-0.282***	-0.190***
	(-8.00)	(-6.23)	(-5.05)	(-5.23)	(-4.34)	(-2.92)	(-5.21)	(-3.85)	(-5.34)	(-4.03)	(-6.04)	(-3.07)
Cash	-0.022	-0.020	0.005	-0.024	-0.034	-0.066	0.006	0.020	-0.065	-0.053	-0.026	-0.011
	(-1.28)	(-1.05)	(0.13)	(-0.58)	(-1.02)	(-0.91)	(0.17)	(0.49)	(-1.24)	(-0.98)	(-1.06)	(-0.37)
Log (PPE/E)	-0.013	0.101**	0.058	0.313***	0.127*	0.173**	0.149**	0.117**	-0.027	-0.117	-0.065	0.050
	(-0.31)	(2.16)	(0.86)	(3.72)	(1.72)	(2.22)	(2.48)	(2.34)	(-0.36)	(-1.34)	(-1.17)	(0.79)
BHAR	-0.058***	-0.054***	-0.073***	-0.053***	-0.067***	-0.051**	-0.042**	-0.015	-0.085***	-0.041	-0.052***	-0.117***
	(-6.72)	(-5.32)	(-3.54)	(-3.50)	(-4.08)	(-2.34)	(-2.38)	(-0.78)	(-2.66)	(-1.29)	(-3.31)	(-4.39)
Tobin's Q	0.744***	0.601***	0.557***	0.518***	0.498***	0.499***	0.883***	0.520***	1.050***	0.639***	0.910***	0.773***

	(13.04)	(12.09)	(5.29)	(8.55)	(6.82)	(6.22)	(9.22)	(5.70)	(6.63)	(5.88)	(8.34)	(8.68)
Sales growth	0.135***	0.143***	0.109***	0.128***	0.032	0.126*	0.164***	0.111***	0.298***	0.221***	0.149***	0.166***
	(7.51)	(8.88)	(3.91)	(5.24)	(1.20)	(1.81)	(5.71)	(4.57)	(3.54)	(5.72)	(5.40)	(6.18)
ROA	-0.733***	-0.683***	-0.628***	-0.688***	-0.522***	-0.666***	-0.793***	-0.549***	-1.038***	-0.760***	-0.831***	-0.775***
	(-11.51)	(-9.52)	(-5.43)	(-5.93)	(-5.67)	(-3.68)	(-7.35)	(-4.90)	(-6.78)	(-7.02)	(-8.12)	(-7.50)
Book leverage	-0.149***	-0.065	-0.337***	-0.248***	-0.129*	-0.042	-0.073	-0.005	-0.086	-0.037	-0.132***	-0.010
	(-4.80)	(-1.48)	(-8.19)	(-4.53)	(-1.72)	(-0.56)	(-1.55)	(-0.07)	(-0.98)	(-0.41)	(-2.76)	(-0.14)
Constant	1.028***	1.610***	1.097***	1.248	0.642***	1.244***	0.917***	1.620***	0.649***	1.803***	1.228**	1.203**
	(4.15)	(4.73)	(3.34)	(1.30)	(3.11)	(5.80)	(6.47)	(10.86)	(3.42)	(8.19)	(2.41)	(2.53)
Observations	69,402	48,672	17,698	11,902	6,478	4,876	13,276	11,099	5,440	4,034	26,510	16,761
Adjusted R^2	0.346	0.367	0.299	0.373	0.369	0.339	0.407	0.307	0.372	0.412	0.383	0.426

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel II: Method 1 (More than Half) - Exchange wise results

The table compares the results of regressions of R&D/Asset on CEO overconfidence when board is overconfident to when board is non-overconfident for NYSE and NASDAQ Exchange separately. CEOs were excluded while constructing board overconfidence measure. The board if considered overconfident in a year if more than two-third (method 2) of board members are overconfident. Under this measure, a CEO can have either overconfidence board or non-overconfidence board in different years of his tenure. *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable = R&D/Total Assets (%)

Galasso and Simcoe (2011)

	Full sample (January 1993-December 2017)				*Dot com bubble (January 1993-March 2000*				*Dot com crash (April 2000-September 2002)*				*Post dot com crash (October 2002-September 2007)*				*Global financial crisis (October 2007-June 2009)*				*Post global financial crisis (July 2009-December 2017)*			
	NYS		*NAS*		*NYS*		*NAS*		*NYS*		*NAS*		*NYS*		*NAS*		*NYS*		*NAS*		*NYS*		*NAS*	
	Non-OC Board	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*
OC_GS67	-0.030	0.080**	0.168	0.183	0.068	0.081	1.127**	0.819**	-0.041	0.171	0.198	0.573	-0.084	0.055	0.104	0.214	-0.134*	0.048	-0.175	0.137	-0.078	0.056	-0.026	-0.175
	(-0.79)	(2.00)	(1.62)	(1.09)	(1.28)	(0.99)	(4.91)	(3.12)	(-0.68)	(1.50)	(1.03)	(1.52)	(-0.95)	(0.61)	(0.91)	(1.16)	(-1.73)	(0.74)	(-0.84)	(0.52)	(-1.26)	(1.15)	(-0.18)	(-0.62)
Log(sale)	0.033	-0.000	-0.266**	-0.122	0.066*	0.078	-0.278**	-0.111	0.113**	0.062	-0.198	-0.092	0.073*	-0.014	-0.211**	-0.140	0.047	-0.092	-0.358**	-0.010	-0.024	-0.050	-0.230**	-0.074
	(1.04)	(-0.01)	(-3.66)	(-1.53)	(1.66)	(1.58)	(-1.99)	(-0.93)	(2.44)	(1.49)	(-1.58)	(-0.68)	(1.67)	(-0.41)	(-2.41)	(-1.09)	(0.90)	(-1.49)	(-3.00)	(-0.08)	(-0.55)	(-1.07)	(-2.66)	(-0.57)
Cash	0.016	0.015	-0.054**	-0.008	0.070**	-0.001	-0.059	-0.038	-0.015	0.023	-0.057	-0.018	-0.051	0.016	0.050	0.085	0.136**	0.003	-0.162**	-0.081	0.004	0.035**	-0.038	-0.007
	(1.20)	(1.38)	(-2.14)	(-0.29)	(2.03)	(-0.04)	(-0.85)	(-0.53)	(-0.43)	(0.76)	(-1.51)	(-0.38)	(-1.63)	(0.83)	(1.40)	(1.65)	(2.16)	(0.07)	(-2.48)	(-1.27)	(0.24)	(2.54)	(-1.05)	(-0.15)
Log (PPE/E)	0.024	0.072**	0.036	0.120	-0.026	0.101*	0.239	0.498**	0.049	0.116**	0.268	0.140	0.048	0.109**	0.189*	0.027	0.008	0.016	0.080	-0.219	0.051	0.025	-0.038	0.128
	(0.76)	(2.25)	(0.41)	(1.31)	(-0.53)	(1.76)	(1.16)	(2.30)	(1.03)	(2.18)	(1.56)	(0.83)	(0.88)	(2.77)	(1.72)	(0.26)	(0.13)	(0.40)	(0.60)	(-1.38)	(1.36)	(0.68)	(-0.38)	(1.05)
BHAR	-0.045**	-0.029**	-0.036**	-0.054**	-0.051**	-0.030**	-0.027	-0.019	-0.075**	-0.025*	-0.009	-0.021	-0.031**	-0.013	-0.046	-0.025	-0.032*	0.003	-0.059	-0.064	-0.042**	-0.067**	-0.045	-0.142**
	(-6.64)	(-4.68)	(-2.29)	(-2.89)	(-2.89)	(-2.20)	(-0.66)	(-0.75)	(-5.45)	(-1.69)	(-0.36)	(-0.63)	(-2.55)	(-0.88)	(-1.52)	(-0.81)	(-1.83)	(0.19)	(-1.44)	(-1.15)	(-4.46)	(-5.22)	(-1.47)	(-3.31)
Tobin's Q	0.339**	0.286**	0.703**	0.580**	0.309**	0.246**	0.267**	0.297**	0.230**	0.256**	0.274**	0.398**	0.445**	0.288**	0.719**	0.490**	0.334**	0.196**	1.113**	0.627**	0.358**	0.342**	1.052**	0.845**
	(6.46)	(7.24)	(9.63)	(9.00)	(3.72)	(3.67)	(2.30)	(4.45)	(3.41)	(6.67)	(4.18)	(5.35)	(4.89)	(3.41)	(8.09)	(4.17)	(2.84)	(2.67)	(5.79)	(5.05)	(4.68)	(5.46)	(8.30)	(7.84)
Sales	0.016	0.011	0.104**	0.145**	0.001	-0.004	0.055	0.094**	-0.061**	-0.020	-0.036	0.069	0.011	0.022	0.123**	0.092**	0.024	0.028	0.266**	0.221**	0.047**	0.018	0.163**	0.194**

growth																						
	(1.58)	(0.97)	(3.65)	(5.59)	(0.07)	(-0.16)	(1.19)	(2.04)	(-4.11)	(-1.49)	(-0.98)	(0.81)	(0.69)	(1.33)	(3.78)	(2.65)	(1.21)	(1.11)	(3.67)	(3.88)	(2.87)	(0.78)	(3.25)	(4.56)
ROA	-0.132***	-0.106***	-0.838***	-0.774***	-0.099	-0.057	-0.615***	-0.567***	-0.032	-0.080*	-0.233***	-0.418***	-0.146***	-0.097***	-0.724***	-0.616***	-0.198***	-0.058	-1.136***	-0.992***	-0.177***	-0.179***	-1.115***	-0.928***
	(-3.98)	(-3.36)	(-9.40)	(-9.74)	(-1.59)	(-0.99)	(-3.18)	(-3.60)	(-0.68)	(-1.84)	(-2.68)	(-2.80)	(-2.55)	(-2.00)	(-8.25)	(-4.38)	(-3.19)	(-1.35)	(-7.42)	(-7.54)	(-3.17)	(-3.11)	(-8.60)	(-7.81)
Book leverage	-0.119***	-0.086***	-0.066	0.013	-0.166***	-0.154***	-0.473***	-0.335***	-0.103*	-0.145***	-0.154*	0.007	-0.118***	-0.096***	0.050	0.151	-0.083**	-0.062	0.034	-0.028	-0.116***	-0.060***	-0.035	0.090
	(-4.62)	(-4.28)	(-1.04)	(0.14)	(-4.20)	(-3.83)	(-4.23)	(-3.29)	(-1.84)	(-3.73)	(-1.78)	(0.06)	(-3.48)	(-2.05)	(0.72)	(1.34)	(-2.45)	(-1.20)	(0.20)	(-0.19)	(-2.70)	(-2.25)	(-0.37)	(0.66)
Constant	1.027***	1.713***	1.164	0.921***	1.033***	2.366***	0.846	0.555	0.645***	1.137***	0.094	0.019	0.698	1.454***	1.890***	0.458	0.296**	1.707***	2.251***	0.105	0.811*	0.854***	-0.835***	0.794*
	(3.76)	(5.80)	(1.58)	(2.19)	(2.66)	(3.62)	(0.55)	(1.46)	(2.75)	(8.09)	(0.36)	(0.04)	(1.54)	(8.70)	(6.70)	(1.08)	(2.29)	(12.17)	(4.01)	(0.32)	(1.83)	(2.12)	(-3.32)	(1.67)
Observations	37,412	26,707	24,869	19,054	10,331	7,013	4,289	3,659	3,407	2,817	2,117	1,666	6,839	6,161	5,102	4,215	2,722	2,007	2,353	1,865	14,113	8,709	11,008	7,649
Adjusted R^2	0.184	0.263	0.373	0.387	0.184	0.256	0.315	0.396	0.190	0.390	0.325	0.303	0.241	0.252	0.401	0.342	0.180	0.256	0.479	0.460	0.201	0.296	0.436	0.447

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: CEO Overconfidence and R&D/Asset when The Board is Overconfident (Galasso and Simcoe, 2011)

Panel I: Method 2 (More than 2/3)

The table lists the results of regressions of R&D/Asset on CEO overconfidence when board is overconfident and when board is non-overconfident. CEOs were excluded while constructing board overconfidence measure. The board if considered overconfident in a year if more than half (method 1) of board members are overconfident. Under this measure, a CEO can have either overconfidence board or non-overconfidence board in different years of his/her tenure. *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%) Galasso and Simcoe (2011)											
	Full sample (January 1993-December 2017)		*Dot com bubble (January 1993-March 2000)*		*Dot com crash (April 2000-September 2002)*		*Post dot com crash (October 2002-September 2007)*		*Global financial crisis (October 2007-June 2009)*		*Post global financial crisis (July 2009-December 2017)*	
	Non-OC Board	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*
OC-_GS67	0.084**	0.137	0.389***	0.285*	0.108	0.235	-0.001	0.055	-0.087	-0.352	-0.052	0.052
	(1.99)	(1.15)	(6.33)	(1.91)	(1.23)	(1.12)	(-0.02)	(0.28)	(-0.85)	(-0.99)	(-0.77)	(0.33)
Log(sale)	-0.276***	-0.223***	-0.269***	-0.239***	-0.315***	-0.181**	-0.244***	-0.217***	-0.320***	-0.214**	-0.260***	-0.207***
	(-8.80)	(-5.18)	(-6.66)	(-3.47)	(-4.94)	(-1.98)	(-5.78)	(-2.67)	(-6.20)	(-2.17)	(-6.01)	(-3.07)
Cash	-0.022	-0.021	0.014	-0.072*	-0.036	-0.058	0.000	0.058	-0.054	-0.082	-0.030	0.008
	(-1.40)	(-0.91)	(0.40)	(-1.89)	(-0.98)	(-1.01)	(0.00)	(1.13)	(-1.14)	(-1.43)	(-1.30)	(0.19)
Log (PPE/E)	0.006	0.127**	0.087	0.395***	0.104*	0.200**	0.126**	0.164**	-0.080	-0.017	-0.037	0.058
	(0.17)	(2.19)	(1.48)	(3.88)	(1.67)	(2.06)	(2.53)	(2.34)	(-1.24)	(-0.14)	(-0.79)	(0.67)
BHAR	-0.058***	-0.046***	-0.070***	-0.034*	-0.061***	-0.044*	-0.028**	-0.030	-0.066***	-0.065	-0.071***	-0.098***
	(-8.13)	(-3.97)	(-4.30)	(-1.75)	(-4.17)	(-1.83)	(-2.05)	(-1.16)	(-2.59)	(-1.26)	(-4.90)	(-3.85)
Tobin's Q	0.699***	0.569***	0.553***	0.477***	0.538***	0.345***	0.738***	0.571***	0.873***	0.637***	0.858***	0.741***

	(15.01)	(9.45)	(7.68)	(6.00)	(8.03)	(4.81)	(9.81)	(4.58)	(7.19)	(5.37)	(9.78)	(6.58)
Sales growth	0.144***	0.117***	0.128***	0.084***	0.073**	0.020	0.156***	0.098***	0.277***	0.222***	0.155***	0.155***
	(9.57)	(5.61)	(5.71)	(2.72)	(2.23)	(0.62)	(6.22)	(3.67)	(4.31)	(4.97)	(6.83)	(3.38)
ROA	-0.743***	-0.602***	-0.683***	-0.573***	-0.604***	-0.420***	-0.763***	-0.499***	-0.972***	-0.746***	-0.828***	-0.733***
	(-13.14)	(-8.18)	(-7.57)	(-4.09)	(-6.14)	(-3.61)	(-7.77)	(-3.78)	(-8.09)	(-5.35)	(-9.05)	(-6.16)
Book leverage	-0.128***	-0.056	-0.309***	-0.275***	-0.095	-0.084	-0.069*	0.074	-0.057	-0.170*	-0.103**	-0.003
	(-4.28)	(-1.06)	(-8.20)	(-4.09)	(-1.51)	(-0.92)	(-1.76)	(0.83)	(-0.78)	(-1.72)	(-2.27)	(-0.03)
Constant	1.140***	1.752***	1.096***	0.305	0.691***	0.254	1.273***	2.572***	0.617*	1.628***	0.908*	0.958***
	(4.19)	(9.74)	(3.31)	(1.25)	(3.56)	(0.71)	(4.14)	(9.58)	(1.92)	(3.91)	(1.94)	(4.40)
Observations	93,312	24,762	23,611	5,989	8,935	2,419	18,501	5,874	7,414	2,060	34,851	8,420
Adjusted R^2	0.352	0.362	0.322	0.364	0.354	0.377	0.385	0.294	0.382	0.368	0.386	0.445

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel II: Method 2 (More than 2/3) - Exchange wise results

The table compares the results of regressions of R&D/Asset on CEO overconfidence when board is overconfident to when board is non-overconfident. CEOs were excluded while constructing board overconfidence measure. The board if considered overconfident in a year if more than two-third (method 2) of board members are overconfident. Under this measure, a CEO can have either overconfidence board or non-overconfidence board in different years of his tenure. *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

Dependent Variable = R&D/Total Assets (%)

Galasso and Simcoe (2011)

	Full sample (January 1993-December 2017)				*Dot com bubble (January 1993-March 2000)*				*Dot com crash (April 2000-September 2002)*				*Post dot com crash (October 2002-September 2007)*				*Global financial crisis (October 2007-June 2009)*				*Post global financial crisis (July 2009-December 2017)*			
	NYS		*NAS*		*NYS*		*NAS*		*NYS*		*NAS*		*NYS*		*NAS*		*NYS*		*NAS*		*NYS*		*NAS*	
	Non-OC Board	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*	*Non-OC Board*	*OC Board*
OC_GS67	-0.018	0.044	0.112	0.275	0.071	-0.042	1.050**	0.695**	-0.003	-0.098	0.149	0.526	-0.072	0.198*	0.120	0.033	-0.133*	0.019	-0.133	-0.370	-0.059	0.040	-0.151	0.239
	(-0.53)	(0.60)	(1.16)	(1.37)	(1.50)	(-0.25)	(5.26)	(2.14)	(-0.05)	(-0.47)	(0.83)	(1.22)	(-0.95)	(1.75)	(1.16)	(0.09)	(-1.91)	(0.11)	(-0.73)	(-0.90)	(-1.09)	(0.50)	(-1.12)	(0.96)
Log(sale)	0.022	0.003	-0.228**	-0.096	0.057	0.112*	-0.220*	-0.086	0.094**	0.064	-0.182*	-0.081	0.048	-0.015	-0.190**	-0.105	0.028	-0.153*	-0.266**	0.076	-0.031	-0.037	-0.189**	-0.054
	(0.80)	(0.08)	(-3.47)	(-1.10)	(1.63)	(1.66)	(-1.93)	(-0.59)	(2.62)	(0.93)	(-1.88)	(-0.35)	(1.34)	(-0.29)	(-2.45)	(-0.50)	(0.67)	(-1.67)	(-2.69)	(0.32)	(-0.79)	(-0.67)	(-2.34)	(-0.39)
Cash	0.016	0.007	-0.042*	-0.016	0.045*	0.001	-0.021	-0.127**	0.005	-0.000	-0.016	-0.092	-0.030	0.007	0.053*	0.134	0.113**	0.002	-0.139**	-0.105	0.008	0.040**	-0.040	0.023
	(1.41)	(0.56)	(-1.85)	(-0.44)	(1.67)	(0.02)	(-0.34)	(-2.03)	(0.17)	(-0.01)	(-0.54)	(-1.18)	(-1.24)	(0.35)	(1.79)	(1.55)	(2.19)	(0.04)	(-2.44)	(-1.32)	(0.61)	(2.21)	(-1.22)	(0.38)
Log (PPE/E)	0.036	0.076**	0.053	0.152	-0.003	0.162**	0.245	0.635**	0.066	0.070	0.149	0.170	0.058	0.154**	0.126	0.102	0.017	0.045	-0.035	-0.040	0.046	0.004	0.022	0.098
	(1.32)	(2.09)	(0.69)	(1.33)	(-0.08)	(2.01)	(1.32)	(2.73)	(1.54)	(1.28)	(1.06)	(0.62)	(1.37)	(3.04)	(1.29)	(0.67)	(0.38)	(0.68)	(-0.30)	(-0.18)	(1.47)	(0.08)	(0.26)	(0.62)
BHAR	-0.040**	-0.034**	-0.044**	-0.045**	-0.044**	-0.036*	-0.025	-0.017	-0.057**	-0.035**	-0.010	-0.020	-0.019	-0.026	-0.041*	-0.008	-0.032**	0.031	-0.035	-0.128	-0.047**	-0.073**	-0.080**	-0.108**
	(-7.03)	(-3.96)	(-3.36)	(-2.12)	(-3.10)	(-1.97)	(-0.82)	(-0.51)	(-4.72)	(-2.30)	(-0.46)	(-0.41)	(-1.55)	(-1.49)	(-1.77)	(-0.19)	(-2.24)	(1.16)	(-1.06)	(-1.45)	(-5.67)	(-3.94)	(-2.94)	(-2.56)
Tobin's Q	0.312**	0.304**	0.660**	0.561**	0.287**	0.239**	0.269**	0.328**	0.263**	0.227**	0.333**	0.328**	0.348**	0.364**	0.616**	0.478**	0.312**	0.117	0.906**	0.562**	0.334**	0.374**	0.967**	0.809**
	(7.87)	(5.49)	(11.13)	(7.04)	(4.37)	(2.24)	(3.25)	(3.69)	(5.64)	(4.16)	(5.68)	(3.03)	(4.70)	(2.80)	(8.51)	(3.07)	(3.26)	(1.02)	(6.30)	(4.03)	(5.78)	(5.63)	(9.84)	(5.40)
Sales growth	0.017**	-0.001	0.119**	0.131**	0.008	-0.038	0.073*	0.076	-0.043**	-0.023	0.020	-0.034	0.017	0.015	0.113**	0.093**	0.025	-0.001	0.240**	0.267**	0.039**	0.024	0.179**	0.174**
	(2.02)	(-0.08)	(5.08)	(3.76)	(0.54)	(-1.15)	(1.88)	(1.35)	(-3.58)	(-1.33)	(0.43)	(-0.48)	(1.32)	(0.60)	(3.81)	(2.34)	(1.63)	(-0.02)	(4.10)	(4.23)	(2.81)	(0.75)	(4.47)	(2.40)
ROA	-0.121**	-0.115**	-0.831**	-0.749**	-0.086	-0.073	-0.602**	-0.519**	-0.066*	-0.030	-0.321**	-0.495**	-0.131**	-0.121*	-0.709**	-0.639**	-0.146**	-0.034	-1.075**	-1.056**	-0.169**	-0.211**	-1.081**	-0.878**
	(-4.20)	(-2.90)	(-11.18)	(-7.50)	(-1.43)	(-1.17)	(-4.15)	(-3.12)	(-1.81)	(-0.47)	(-3.61)	(-2.74)	(-2.91)	(-1.92)	(-9.27)	(-3.96)	(-3.29)	(-0.44)	(-8.97)	(-5.26)	(-3.57)	(-3.33)	(-9.81)	(-5.48)
Book leverage	-0.111**	-0.077**	-0.047	0.026	-0.149**	-0.224**	-0.440**	-0.194	-0.124**	-0.104**	-0.071	0.119	-0.118**	-0.085	0.056	0.246	-0.065**	-0.071	0.037	-0.279	-0.106**	-0.038	0.005	0.048
	(-5.31)	(-2.80)	(-0.74)	(0.23)	(-4.49)	(-3.47)	(-4.89)	(-1.38)	(-2.86)	(-2.13)	(-0.85)	(0.47)	(-3.58)	(-1.33)	(0.87)	(1.52)	(-1.98)	(-1.28)	(0.29)	(-1.48)	(-3.18)	(-1.05)	(0.05)	(0.22)

Constant	1.155***	1.902***	1.430*	0.459	1.250***	0.207	1.139	0.249	0.646***	0.024	-0.109	-0.507	1.378***	1.992***	1.973***	1.557***	0.401	1.717***	-0.346	-0.396	0.933***	0.051	-0.565***	0.452
	(3.91)	(11.29)	(1.95)	(1.37)	(2.78)	(0.83)	(0.76)	(0.59)	(2.78)	(0.11)	(-0.34)	(-0.90)	(3.16)	(12.25)	(8.13)	(2.77)	(1.44)	(6.52)	(-1.33)	(-0.73)	(2.27)	(0.49)	(-3.45)	(1.32)
Observations	50,814	13,305	33,989	9,934	13,871	3,473	6,044	1,904	4,784	1,440	3,037	746	9,689	3,311	7,130	2,187	3,749	980	3,226	992	18,721	4,101	14,552	4,105
Adjusted R^2	0.193	0.284	0.378	0.377	0.191	0.283	0.348	0.382	0.240	0.405	0.292	0.372	0.228	0.271	0.397	0.323	0.174	0.281	0.489	0.385	0.208	0.335	0.434	0.452

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Alternative Explanation of The Effects of Financial Constraints

This table presents the coefficient of CEO overconfidence for regressions analysis of financial constraints. Four measures of financial constraints are used: firm Cash, Leverage, Size and Kaplan-Zingales index. Firms with higher than median of these measures are considered in "high".

		Dependent Variable = R&D/Total Assets (%)											
		Full sample (January 1993-December 2017)		*Dot com bubble (January 1993-March 2000)*		*Dot com crash (April 2000-September 2002)*		*Post dot com crash (October 2002-September 2007)*		*Global financial crisis (October 2007-June 2009)*		*Post global financial crisis (July 2009-December 2017)*	
		High	*Low*	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*	*Low*
Cash	*All*	0.055	0.075*	0.331***	0.336***	0.102	0.099	-0.034	-0.004	-0.276*	-0.076	-0.069	-0.051
		(1.39)	(1.72)	(4.81)	(5.87)	(1.23)	(1.10)	(-0.56)	(-0.05)	(-1.70)	(-0.66)	(-1.16)	(-0.70)
	NYSE	-0.010	-0.023	0.032	0.068	0.074	-0.070	-0.047	-0.049	-0.119	-0.099	-0.039	-0.069

		(-0.30)	(-0.66)	(0.57)	(1.46)	(1.38)	(-1.15)	(-0.81)	(-0.59)	(-1.28)	(-1.56)	(-0.83)	(-1.20)
	NASDAQ	0.062	0.096	0.881***	0.926***	0.209	0.144	0.032	0.126	-0.276*	-0.100	-0.168	-0.159
		(0.73)	(0.95)	(4.68)	(4.94)	(1.00)	(0.88)	(0.30)	(1.18)	(-1.70)	(-0.49)	(-1.52)	(-1.05)
Leverage	*All*	-0.002	0.127**	0.266***	0.358***	0.016	0.181*	-0.115	0.098	-0.140	-0.066	-0.118	-0.014
		(-0.05)	(2.34)	(4.57)	(4.19)	(0.16)	(1.65)	(-1.19)	(1.43)	(-0.50)	(-0.57)	(-1.52)	(-0.16)
	NYSE	-0.054	0.018	0.074	-0.009	-0.074	0.061	-0.141	0.025	-0.152*	-0.050	-0.108*	0.007
		(-1.49)	(0.42)	(1.63)	(-0.12)	(-1.21)	(0.97)	(-1.46)	(0.35)	(-1.78)	(-0.51)	(-1.86)	(0.09)
	NASDAQ	-0.000	0.156	0.661***	1.022***	0.049	0.271	0.023	0.146	-0.140	-0.146	-0.244	-0.072
		(-0.00)	(1.44)	(2.68)	(4.67)	(0.23)	(1.29)	(0.16)	(1.31)	(-0.50)	(-0.81)	(-1.26)	(-0.48)
Size	*All*	0.021	0.097	0.154**	0.473***	0.028	0.180	-0.114	0.052	0.043	-0.190	-0.030	-0.101
		(0.50)	(1.55)	(2.47)	(5.53)	(0.36)	(1.31)	(-1.45)	(0.52)	(0.25)	(-1.15)	(-0.52)	(-0.96)
	NYSE	-0.061	0.061	-0.029	0.150***	-0.048	0.095	-0.104	0.068	-0.164*	-0.037	-0.078	-0.012
		(-1.50)	(1.35)	(-0.48)	(2.97)	(-0.70)	(1.51)	(-1.02)	(1.23)	(-1.92)	(-0.35)	(-1.28)	(-0.14)
	NASDAQ	0.234**	-0.031	1.016***	0.774***	0.458*	-0.089	-0.058	0.073	0.043	-0.340	0.127	-0.331*
		(2.16)	(-0.26)	(3.83)	(3.90)	(1.90)	(-0.42)	(-0.37)	(0.64)	(0.25)	(-1.47)	(0.99)	(-1.87)
Kaplan-Zingales index	*All*	0.053	0.077*	0.327***	0.320***	0.137	0.060	-0.042	0.010	-0.228	-0.101	-0.088	-0.027
		(1.03)	(1.69)	(4.92)	(4.40)	(1.20)	(0.68)	(-0.42)	(0.16)	(-0.84)	(-1.04)	(-1.01)	(-0.38)
	NYSE	-0.018	-0.016	0.027	0.065	0.009	-0.008	-0.089	-0.009	-0.060	-0.165	-0.033	-0.078
		(-0.50)	(-0.38)	(0.53)	(1.14)	(0.14)	(-0.12)	(-0.89)	(-0.14)	(-0.92)	(-1.54)	(-0.67)	(-0.97)
	NASDAQ	0.011	0.122	0.814***	0.802***	0.197	0.029	0.112	0.083	-0.228	-0.101	-0.342*	0.002
		(0.08)	(1.41)	(3.78)	(4.29)	(0.89)	(0.16)	(0.84)	(0.74)	(-0.84)	(-0.66)	(-1.65)	(0.01)

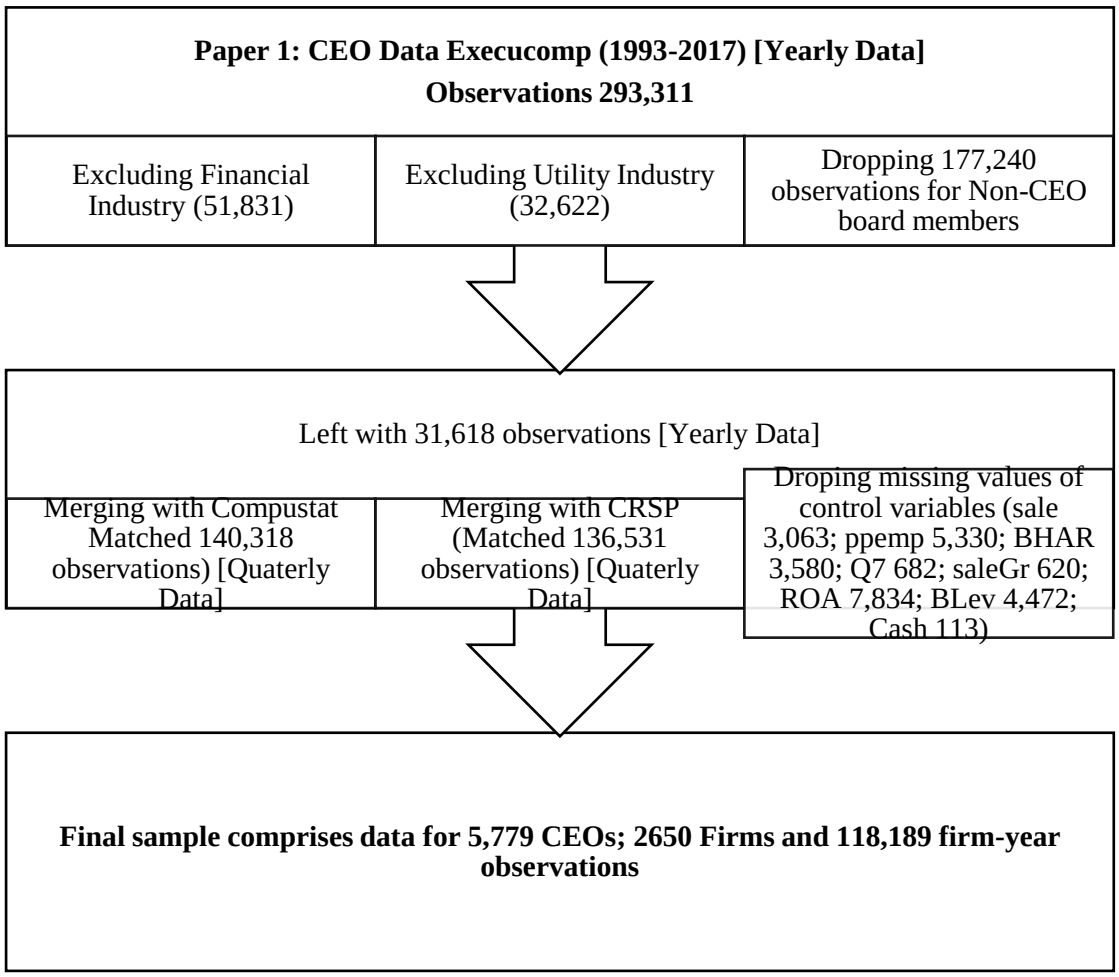
t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

9. Appendix

9.1. Appendix I (A): Data Filtering Process

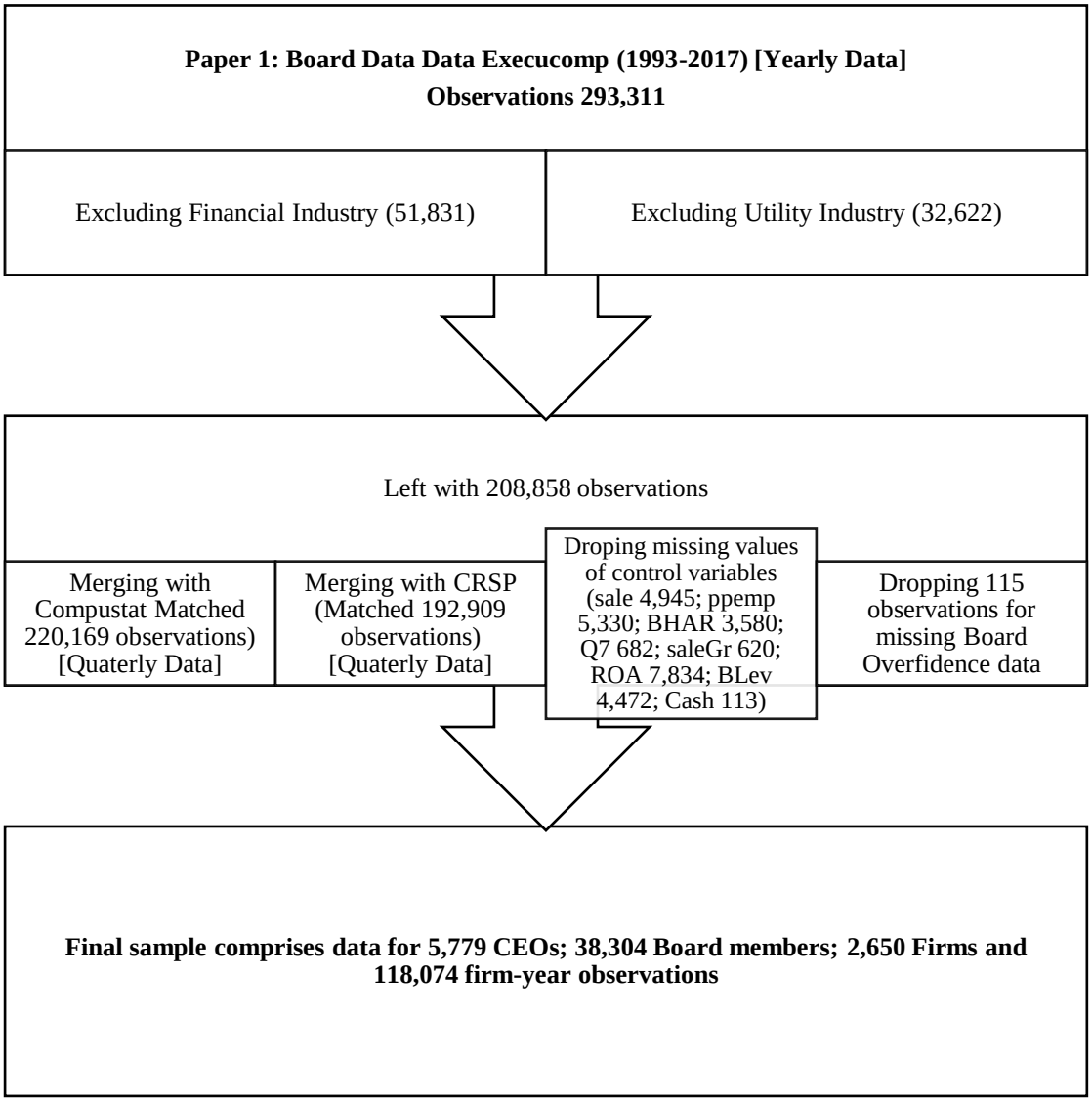
9.1.1. Panel I: CEO Data

For sample period of January 1993-December 2017, we used Execucomp to obtain data on executive stock options. We excluded the financial and utility industries, observations for non-CEO executives and duplicate data. We had 31,618 yearly observations at this point. We then merged this data with Compustat's Quarterly financial and accounting variables and Quarterly stock returns from the Center for Research in Security Prices (CRSP) using GVKEY, quarter and year. Any missing data for control variables was discarded. Between 1993 and 2017, this approach yielded a final sample of 5,779 CEOs, 2650 Firms and 118,189 firm-year observations.



9.1.2. Panel II: Board Executives Data

For sample period of January 1993- December 2017, we used Execucomp to obtain data on executive stock options. We excluded the financial and utility industries; and had 208,858 observations at this point. We then merged this data with Compustat's Quarterly financial and accounting variables and Quarterly stock returns from the Center for Research in Security Prices (CRSP) database using GVKEY, quater and year. Any missing data for control variables was discarded. Between 1993 and 2017, this approach yielded a final sample of 5,779 CEOs, 38,304 Board members, 2,650 Firms and 118,074 firm-year observations.



9.2. Appendix I (B): Variable Definition

Dependent variable	
R&D/Assets	Research and development expenditures (xrd) scaled by total assets (at). Missing values of R&D are coded with 0.
Independent variable (lagged values)	
OC_GS67	Indicator variable that takes a value of 1 for all CEO-quarters if the CEO postpones the exercise of vested options that are at least 67% in the money at least twice during the tenure, in any two years, or 0 otherwise.
OC_GS100	Indicator variable that takes a value of 1 for all CEO-quarters if the CEO postpones the exercise of vested options that are at least 100% in the money at least twice during the tenure, in any two years, and 0 otherwise.
OC_MT67	Indicator variable that takes a value of 1 after the first year, if a CEO postpones the exercise of vested options that are at least 67% in the money at least twice during the tenure, in any two years, or 0 otherwise.
OC_MT100	Indicator variable that takes a value of 1 after the first year, if a CEO postpones the exercise of vested options that are at least 100% in the money at least twice during the tenure, in any two years, or 0 otherwise.
Board Overconfidence	Stock options-based measure of executives' overconfidence equals 1 for all quarters (Galasso and Simcoe, 2011) or after the first year (Malmendier and Tate, 2005) executives hold options that are at least 67% in the money, and 0 otherwise; conditional of holding at least twice during the tenure. In a year, the board is considered overconfident if more than half (method 1) or two-third (method 2) of board executives are overconfident. Under this measure, a CEO can have overconfident board or non-overconfident board in different years.
Control variables (lagged values)	
Cash	Ratio of cash (ch) to total assets (at).
Log(sale)	Natural logarithm of sales (sale).
Log (PPE/E)	Natural logarithm of the ratio of net property, plant, and equipment (ppent) to employees (emp).
BHAR	Buy-and-hold return over the quarter.
Tobin's Q	Ratio of market value (at+(csho*prcc_f)- ceq- pstkl- txdb) to book value (at) of firm.
Sales growth	Log transformation of sales (sale) divided by prior-quater sales.
ROA	Ratio of operating income before depreciation (oibdp) to total assets (at).
Book leverage	Ratio of total debt (dltt+dlc) to book value of assets (at).
CEO duality	A dummy variable, 1 when CEOs are assigned as chairperson/president, and 0 otherwise.
Board size	Total number of directors on board for a quarter.

Log (Pay inequality)	Log transformation of ratio of CEOs salary (tdc1) to average board members salary.

9.4. Appendix I (C)

Table 14: Board Overconfidence and R&D/Asset (%) (Malmendier and Tate, 2005)

The table presents the results of regressions of R&D/Asset on Board overconfidence. The dependent variable is the ratio of R&D expenditure to total asset. Missing values of R&D are replaced with 0. CEOs are excluded from the sample. A Board is considered overconfident if more than half (50%) or two-third (75%) holds options that are at least 67% in the money. Overconfident Board is a dummy variable equal to 1 if the board displays overconfidence and 0 if the board is non-overconfidence. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. Variable definitions are provided in the Appendix I (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

Method 1: More than half

	Dependent Variable = R&D/Total Assets (%) Malmendier And Tate (2005)					
	Full sample (January 1993-December 2017)	*Dot com bubble (January 1993-March 2000)*	*Dot com crash (April 2000-September 2002)*	*Post dot com crash (October 2002-September 2007)*	*Global financial crisis (October 2007-June 2009)*	*Post global financial crisis (July 2009-December 2017)*
Board Overconfidence	-0.099***	-0.065	-0.140	-0.037	-0.135**	-0.139**
	(-2.59)	(-0.95)	(-1.63)	(-0.69)	(-2.02)	(-2.43)
Log(sale)	-0.264***	-0.256***	-0.292***	-0.241***	-0.297***	-0.245***
	(-8.95)	(-6.68)	(-5.17)	(-6.27)	(-6.47)	(-6.12)
Cash	-0.024*	-0.007	-0.041	0.011	-0.065	-0.024
	(-1.76)	(-0.24)	(-1.31)	(0.42)	(-1.63)	(-1.19)
Log (PPE/E)	0.032	0.134**	0.127**	0.127***	-0.077	-0.018
	(0.94)	(2.57)	(2.38)	(3.06)	(-1.34)	(-0.42)
BHAR	-0.056***	-0.058***	-0.061***	-0.030**	-0.067***	-0.076***
	(-8.63)	(-4.24)	(-4.81)	(-2.46)	(-2.83)	(-5.70)
Tobin's Q	0.667***	0.546***	0.498***	0.681***	0.807***	0.823***
	(16.18)	(8.88)	(8.80)	(9.96)	(8.65)	(11.11)
Sales growth	0.138***	0.121***	0.068**	0.143***	0.260***	0.153***
	(10.49)	(6.12)	(2.33)	(6.69)	(4.97)	(7.35)
ROA	-0.711***	-0.658***	-0.580***	-0.705***	-0.916***	-0.805***
	(-13.65)	(-7.74)	(-6.39)	(-8.06)	(-9.16)	(-10.10)

Book leverage	-0.114***	-0.277***	-0.082	-0.037	-0.087	-0.087**
	(-3.84)	(-8.13)	(-1.42)	(-0.92)	(-1.40)	(-2.05)
Constant	1.192***	1.292***	0.744***	1.027***	0.930**	0.882*
	(4.17)	(4.05)	(3.95)	(2.90)	(2.18)	(1.92)
Observations	118,074	29,600	11,354	24,375	9,474	43,271
Adjusted R^2	0.351	0.320	0.353	0.358	0.378	0.393

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Method 2: More than two-third

	Dependent Variable = R&D/Total Assets (%) Malmendier And Tate (2005)					
	Full sample (January 1993-December 2017)	*Dot com bubble (January 1993-March 2000)*	*Dot com crash (April 2000-September 2002)*	*Post dot com crash (October 2002-September 2007)*	*Global financial crisis (October 2007-June 2009);*	*Post global financial crisis (July 2009-December 2017)*
Board Overconfidence	-0.142***	-0.275***	-0.193**	-0.056	-0.047	-0.173***
	(-3.45)	(-3.24)	(-2.29)	(-0.83)	(-0.53)	(-2.89)
Log(sale)	-0.265***	-0.259***	-0.292***	-0.242***	-0.299***	-0.246***
	(-8.98)	(-6.75)	(-5.16)	(-6.30)	(-6.49)	(-6.15)
Cash	-0.024*	-0.008	-0.041	0.012	-0.064	-0.024
	(-1.74)	(-0.26)	(-1.33)	(0.43)	(-1.60)	(-1.19)
Log (PPE/E)	0.031	0.135**	0.127**	0.126***	-0.076	-0.019
	(0.92)	(2.58)	(2.39)	(3.04)	(-1.34)	(-0.44)
BHAR	-0.056***	-0.058***	-0.061***	-0.030**	-0.067***	-0.076***
	(-8.61)	(-4.24)	(-4.73)	(-2.46)	(-2.83)	(-5.72)
Tobin's Q	0.665***	0.547***	0.496***	0.680***	0.798***	0.818***
	(16.07)	(8.98)	(8.56)	(9.90)	(8.64)	(11.06)
Sales growth	0.138***	0.121***	0.068**	0.143***	0.261***	0.153***
	(10.49)	(6.12)	(2.36)	(6.71)	(4.98)	(7.34)
ROA	-0.712***	-0.656***	-0.581***	-0.705***	-0.920***	-0.806***
	(-13.72)	(-7.73)	(-6.53)	(-8.11)	(-9.17)	(-10.14)
Book leverage	-0.114***	-0.280***	-0.083	-0.036	-0.085	-0.087**
	(-3.86)	(-8.25)	(-1.45)	(-0.91)	(-1.36)	(-2.07)
Constant	1.186***	1.278***	0.734***	1.017***	0.890**	0.859*
	(4.19)	(4.04)	(3.89)	(2.91)	(2.22)	(1.88)
Observations	118,074	29,600	11,354	24,375	9,474	43,271
Adjusted R^2	0.351	0.321	0.353	0.358	0.377	0.393

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 14 shows R&D investment is significantly affected by board overconfidence across different sample frames, measured using Malmendier and Tate (2005). While constructing a board overconfident measure, CEOs are excluded. Overconfidence is calculated in the same way for board members as it is for CEOs. As a result, if more than half (method 1) or two-thirds (method 2) of board executives are overconfident in a year, the board is termed overconfident. In contrast to overconfident CEOs, an overconfident board invests less in R&D for full sample; and spends significantly less during 2007-08 financial crisis periods. We believe that as a result of greater scrutiny and corporate governance, the board of directors' position in the company has become more prominent, and they have surpassed the CEOs. As a result, businesses appear to invest less in R&D, contradicting prior research results that "overconfident CEOs means more R&D."

Using method two, we find consistent results, however this shows more significant decrease in R&D investment after both dot-com bubble and global financial crisis.

Table 15: Robustness checks for GS100, MT67 and MT100

The table presents the results of regressions of R&D/Asset on CEO overconfidence during different robustness checks for overconfidence measure and for different sub-samples. The dependent variable is the ratio of R&D expenditure to total asset. Missing values of R&D are replaced with 0. A CEO is considered overconfident if he holds options that are at least 67% or 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years (Galasso and Simcoe (2011)) or after the first year (Malmendier and Tate (2005)) CEO displays overconfidence if he displayed overconfidence at least twice during the tenure, and 0 otherwise. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. Variable definitions are provided in the Appendix I (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

Panel I: CEO Overconfidence and R&D/Asset (%)

The table presents regression estimates of R&D/Asset on CEO overconfidence. The dependent variable is the ratio of R&D expenditure to total asset. Missing values of R&D are replaced with 0. A CEO is considered overconfident if he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years (Galasso and Simcoe (2011)) CEO displays overconfidence if he displayed overconfidence at least twice during the tenure, and 0 otherwise. All independent variables are lagged by 1 year. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. Variable definitions are provided in the Appendix I (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
	Full sample (January 1993-December 2017)	*Dot com bubble (January 1993-March 2000)*	*Dot com crash (April 2000-September 2002)*	*Post dot com crash (October 2002-September 2007)*	*Global financial crisis (October 2007-June 2009)*	*Post global financial crisis (July 2009-December 2017)*
CEO_GS100	0.082**	0.348***	0.103	0.023	-0.068	-0.052
	(2.19)	(6.22)	(1.36)	(0.41)	(-0.78)	(-0.87)
Log(sale)	-0.263***	-0.250***	-0.287***	-0.240***	-0.303***	-0.247***
	(-8.87)	(-6.66)	(-5.14)	(-6.20)	(-6.51)	(-6.17)
Cash	-0.024*	-0.008	-0.042	0.011	-0.061	-0.025
	(-1.78)	(-0.29)	(-1.33)	(0.42)	(-1.53)	(-1.24)

Log (PPE/E)	0.032	0.148***	0.128**	0.126***	-0.077	-0.017
	(0.95)	(2.87)	(2.42)	(3.04)	(-1.35)	(-0.41)
BHAR	-0.056***	-0.063***	-0.062***	-0.030**	-0.064***	-0.076***
	(-8.91)	(-4.63)	(-4.75)	(-2.47)	(-2.76)	(-5.71)
Tobin's Q	0.655***	0.525***	0.488***	0.678***	0.800***	0.809***
	(15.81)	(8.74)	(8.46)	(9.81)	(8.57)	(10.93)
Sales growth	0.138***	0.118***	0.069**	0.143***	0.261***	0.152***
	(10.45)	(6.02)	(2.39)	(6.74)	(5.00)	(7.22)
ROA	-0.718***	-0.667***	-0.590***	-0.709***	-0.925***	-0.807***
	(-13.88)	(-7.89)	(-6.55)	(-8.28)	(-9.33)	(-10.13)
Book leverage	-0.112***	-0.284***	-0.080	-0.036	-0.083	-0.082**
	(-3.80)	(-8.42)	(-1.39)	(-0.91)	(-1.33)	(-1.98)
Constant	1.159***	1.120***	0.668***	1.325***	0.913**	1.243***
	(4.21)	(3.40)	(3.57)	(3.81)	(2.20)	(2.61)
Observations	118,189	29,613	11,357	24,377	9,482	43,360
Adjusted R^2	0.351	0.325	0.353	0.358	0.379	0.393

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel II: CEO Overconfidence and R&D/Asset (%) for NYSE and NASDAQ-listed firms (Galasso and Simcoe, 2011)

The table demonstrates the results of regressions of R&D/Asset on CEO overconfidence for NYSE and NASDAQ-listed firms separately for each sample period. A CEO is considered overconfident if he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years if he displayed overconfidence at least twice during the tenure, and 0 otherwise. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%) Galasso and Simcoe (2011)											
	Full sample (January 1993-December 2017)		*Dot com bubble (January 1993-March 2000)*		*Dot com crash (April 2000-September 2002)*		*Post dot com crash (October 2002-September 2007)*		*Global financial crisis (October 2007-June 2009)*		*Post global financial crisis (July 2009-December 2017)*	
	NYS	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*
OC_GS100	0.027	0.090	0.111**	0.834***	0.044	0.121	0.015	0.109	-0.018	-0.166	-0.033	-0.171
	(1.00)	(1.06)	(2.51)	(5.06)	(1.04)	(0.78)	(0.29)	(1.12)	(-0.33)	(-1.06)	(-0.76)	(-1.43)
Log(sale)	0.019	-0.199***	0.066**	-0.181*	0.082***	-0.165*	0.036	-0.176**	-0.002	-0.198**	-0.036	-0.166**
	(0.72)	(-3.26)	(2.04)	(-1.84)	(2.58)	(-1.80)	(1.19)	(-2.33)	(-0.05)	(-2.20)	(-1.00)	(-2.17)
Cash	0.014	-0.037*	0.031	-0.052	0.004	-0.031	-0.020	0.066**	0.087**	-0.126**	0.015	-0.035
	(1.51)	(-1.87)	(1.35)	(-1.03)	(0.16)	(-1.07)	(-1.03)	(2.17)	(2.01)	(-2.56)	(1.27)	(-1.20)
Log (PPE/E)	0.044*	0.074	0.037	0.311**	0.066*	0.141	0.072**	0.109	0.020	-0.069	0.038	0.049
	(1.76)	(1.06)	(0.97)	(2.02)	(1.80)	(1.14)	(2.08)	(1.32)	(0.55)	(-0.66)	(1.34)	(0.60)
BHAR	-0.039***	-0.044***	-0.043***	-0.026	-0.053***	-0.014	-0.022**	-0.033	-0.020	-0.053	-0.050***	-0.088***
	(-8.05)	(-3.78)	(-3.61)	(-1.03)	(-5.28)	(-0.69)	(-2.16)	(-1.54)	(-1.56)	(-1.59)	(-6.47)	(-3.66)
Tobin's Q	0.302***	0.617***	0.274***	0.275***	0.251***	0.317***	0.342***	0.573***	0.275***	0.782***	0.333***	0.897***
	(8.71)	(11.70)	(4.66)	(4.01)	(6.64)	(6.00)	(4.90)	(7.05)	(3.48)	(7.16)	(6.91)	(10.31)
Sales growth	0.013	0.121***	-0.001	0.070**	-0.041***	0.016	0.016	0.109***	0.019	0.236***	0.037***	0.172***

	(1.57)	(5.86)	(-0.10)	(2.10)	(-3.78)	(0.39)	(1.35)	(4.26)	(1.31)	(4.75)	(2.64)	(4.73)
ROA	-0.118***	-0.821***	-0.081	-0.595***	-0.060*	-0.359***	-0.129***	-0.698***	-0.126***	-1.068***	-0.176***	-1.034***
	(-4.64)	(-12.44)	(-1.60)	(-4.67)	(-1.77)	(-4.43)	(-3.26)	(-8.54)	(-3.27)	(-10.23)	(-4.14)	(-10.64)
Book leverage	-0.103***	-0.031	-0.150***	-0.371***	-0.114***	-0.045	-0.102***	0.100	-0.071**	-0.016	-0.093***	0.016
	(-5.63)	(-0.51)	(-4.94)	(-4.89)	(-3.11)	(-0.57)	(-3.22)	(1.45)	(-2.37)	(-0.15)	(-3.23)	(0.19)
Constant	1.177***	1.521**	1.267***	1.393	0.716***	0.113	1.021**	1.881***	0.585	1.760***	0.729*	0.898***
	(4.01)	(2.10)	(2.81)	(1.01)	(3.05)	(0.43)	(2.54)	(7.14)	(1.58)	(4.24)	(1.74)	(3.82)
Observations	64,147	44,009	17,344	7,960	6,224	3,786	13,002	9,317	4,735	4,220	22,842	18,726
Adjusted R^2	0.209	0.375	0.204	0.344	0.274	0.308	0.233	0.372	0.187	0.464	0.226	0.431

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel III: CEO Overconfidence and R&D/Asset (%) [Malmendier and Tate (2005)]

The table presents regression estimates of R&D/Asset on CEO overconfidence. The dependent variable is the ratio of R&D expenditure to total asset. Missing values of R&D are replaced with 0. A CEO is considered overconfident if he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 after the first year (Malmendier and Tate (2005)) CEO displays overconfidence if he displayed overconfidence at least twice during the tenure, and 0 otherwise. All independent variables are lagged by 1 year. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. Variable definitions are provided in the Appendix I (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%) Malmendier and Tate (2005)					
	Full sample (January 1993-December 2017)	*Dot com bubble (January 1993-March 2000)*	*Dot com crash (April 2000-September 2002)*	*Post dot com crash (October 2002-September 2007)*	*Global financial crisis (October 2007-June 2009)*	*Post global financial crisis (July 2009-December 2017)*
CEO_MT67	0.049	0.280***	0.135**	0.046	-0.070	-0.102*
	(1.53)	(5.06)	(1.96)	(0.92)	(-0.97)	(-1.84)
Log(sale)	-0.265***	-0.262***	-0.289***	-0.241***	-0.300***	-0.246***
	(-8.97)	(-6.87)	(-5.14)	(-6.24)	(-6.53)	(-6.15)
Cash	-0.024*	-0.006	-0.042	0.011	-0.061	-0.025
	(-1.75)	(-0.21)	(-1.34)	(0.42)	(-1.52)	(-1.24)
Log (PPE/E)	0.032	0.142***	0.132**	0.127***	-0.077	-0.017
	(0.96)	(2.74)	(2.49)	(3.05)	(-1.35)	(-0.40)
BHAR	-0.056***	-0.061***	-0.060***	-0.030**	-0.065***	-0.075***
	(-8.71)	(-4.45)	(-4.72)	(-2.45)	(-2.76)	(-5.66)
Tobin's Q	0.656***	0.526***	0.485***	0.677***	0.801***	0.813***
	(15.82)	(8.82)	(8.44)	(9.81)	(8.56)	(10.96)
Sales growth	0.139***	0.122***	0.069**	0.143***	0.260***	0.152***
	(10.50)	(6.19)	(2.40)	(6.76)	(5.00)	(7.22)
ROA	-0.717***	-0.668***	-0.590***	-0.710***	-0.924***	-0.804***
	(-13.84)	(-7.92)	(-6.57)	(-8.26)	(-9.32)	(-10.11)
Book leverage	-0.112***	-0.285***	-0.080	-0.036	-0.085	-0.083**
	(-3.79)	(-8.41)	(-1.39)	(-0.91)	(-1.36)	(-2.00)
Constant	1.187***	1.235***	0.667***	1.314***	0.910**	1.261***

	(4.25)	(3.83)	(3.41)	(3.83)	(2.20)	(2.60)
Observations	118,189	29,613	11,357	24,377	9,482	43,360
Adjusted R^2	0.351	0.324	0.353	0.358	0.379	0.393

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel IV: CEO Overconfidence and R&D/Asset (%) with Control Variables (Malmendier and Tate (2005)

The table demonstrates the results of regressions of R&D/Asset on CEO overconfidence with control variables. A CEO is considered overconfident if he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 after the first year if he displayed overconfidence at least twice during the tenure, and 0 otherwise. While constructing board overconfidence, we only include non-CEO executives. All independent variables are lagged by 1 year. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%) Malmendier and Tate (2005)					
	Full sample (January 1993-December 2017)	*Dot com bubble (January 1993-March 2000)*	*Dot com crash (April 2000-September 2002)*	*Post dot com crash (October 2002-September 2007)*	*Global financial crisis (October 2007-June 2009)*	*Post global financial crisis (July 2009-December 2017)*
CEO_MTS67	0.062*	0.294***	0.143**	0.049	-0.017	-0.088
	(1.89)	(5.29)	(2.08)	(0.95)	(-0.25)	(-1.56)
CEO duality	-0.015	0.057	-0.116	-0.038	-0.032	-0.015
	(-0.43)	(0.82)	(-1.33)	(-0.56)	(-0.50)	(-0.30)
Board Size	-0.057*	-0.096	-0.046	0.036	-0.030	-0.119***
	(-1.95)	(-1.57)	(-0.80)	(0.73)	(-0.56)	(-2.74)
Log (pay inequality)	0.048***	0.151***	0.017	-0.030	0.008	0.049*
	(2.76)	(5.54)	(0.27)	(-0.96)	(0.26)	(1.87)
Log(sale)	-0.269***	-0.283***	-0.285***	-0.238***	-0.281***	-0.256***
	(-8.94)	(-7.23)	(-5.08)	(-6.13)	(-5.63)	(-6.25)
Cash	-0.022	-0.001	-0.040	-0.008	-0.027	-0.024
	(-1.63)	(-0.04)	(-1.24)	(-0.28)	(-0.70)	(-1.20)
Log (PPE/E)	0.041	0.161***	0.133**	0.141***	-0.020	-0.023
	(1.22)	(3.29)	(2.44)	(3.34)	(-0.36)	(-0.54)
BHAR	-0.052***	-0.057***	-0.061***	-0.031**	-0.046**	-0.073***
	(-8.22)	(-3.98)	(-4.74)	(-2.49)	(-2.28)	(-5.53)
Tobin's Q	0.654***	0.541***	0.485***	0.665***	0.752***	0.811***
	(15.19)	(8.98)	(8.17)	(8.73)	(7.09)	(10.98)
Sales growth	0.136***	0.133***	0.071**	0.140***	0.202***	0.153***
	(10.89)	(6.51)	(2.39)	(5.96)	(6.86)	(7.23)
ROA	-0.693***	-0.663***	-0.585***	-0.685***	-0.736***	-0.802***

	(-13.18)	(-7.47)	(-6.21)	(-7.01)	(-9.38)	(-10.14)
Book leverage	-0.106***	-0.287***	-0.078	-0.024	-0.042	-0.085**
	(-3.49)	(-8.16)	(-1.35)	(-0.58)	(-0.59)	(-2.03)
Constant	1.173***	0.899**	0.615	1.486***	0.987**	1.019**
	(3.97)	(2.52)	(1.51)	(3.79)	(2.27)	(2.02)
Observations	114,118	27,498	11,110	23,629	8,521	43,360
Adjusted R^2	0.350	0.333	0.350	0.344	0.352	0.394

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel V: CEO Overconfidence and R&D/Asset (%) for NYSE and NASDAQ-listed firms (Malmendier and Tate, 2005)

The table demonstrates the results of regressions of R&D/Asset on CEO overconfidence for NYSE and NASDAQ-listed firms separately for each sample period. A CEO is considered overconfident if he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years if he displayed overconfidence at least twice during the tenure, and 0 otherwise. All independent variables are lagged by 1 quarter. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%) Malmendier and Tate (2005)											
	Full sample (January 1993-December 2017)		*Dot com bubble (January 1993-March 2000)*		*Dot com crash (April 2000-September 2002)*		*Post dot com crash (October 2002-September 2007)*		*Global financial crisis (October 2007-June 2009)*		*Post global financial crisis (July 2009-December 2017)*	
	NYS	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*
OC_MT67	-0.008	0.049	0.054	0.566***	-0.000	0.188	-0.008	0.167*	-0.059	-0.125	-0.051	-0.230**
	(-0.34)	(0.71)	(1.42)	(3.96)	(-0.01)	(1.40)	(-0.17)	(1.88)	(-1.15)	(-0.94)	(-1.28)	(-2.11)
Log(sale)	0.018	-0.201***	0.063*	-0.219**	0.079**	-0.168*	0.034	-0.179**	-0.001	-0.193**	-0.034	-0.164**
	(0.68)	(-3.29)	(1.92)	(-2.10)	(2.50)	(-1.84)	(1.14)	(-2.38)	(-0.04)	(-2.15)	(-0.97)	(-2.16)
Cash	0.014	-0.037*	0.032	-0.051	0.004	-0.033	-0.020	0.066**	0.087**	-0.124**	0.014	-0.034
	(1.51)	(-1.88)	(1.39)	(-1.01)	(0.17)	(-1.14)	(-1.01)	(2.16)	(2.01)	(-2.54)	(1.25)	(-1.19)
Log (PPE/E)	0.044*	0.074	0.033	0.310*	0.066*	0.141	0.072**	0.109	0.020	-0.069	0.039	0.046
	(1.75)	(1.07)	(0.86)	(1.94)	(1.80)	(1.15)	(2.10)	(1.33)	(0.56)	(-0.66)	(1.37)	(0.56)
BHAR	-0.039***	-0.044***	-0.042***	-0.023	-0.052***	-0.013	-0.022**	-0.033	-0.020	-0.053	-0.050***	-0.088***
	(-7.90)	(-3.71)	(-3.53)	(-0.92)	(-5.22)	(-0.64)	(-2.15)	(-1.54)	(-1.54)	(-1.61)	(-6.48)	(-3.67)
Tobin's Q	0.303***	0.618***	0.277***	0.281***	0.252***	0.316***	0.342***	0.572***	0.277***	0.782***	0.335***	0.901***
	(8.69)	(11.73)	(4.70)	(4.04)	(6.65)	(5.95)	(4.90)	(7.07)	(3.49)	(7.14)	(6.89)	(10.34)
Sales growth	0.013	0.121***	0.000	0.078**	-0.040***	0.017	0.016	0.109***	0.018	0.234***	0.036***	0.170***

	(1.60)	(5.88)	(0.01)	(2.28)	(-3.76)	(0.41)	(1.36)	(4.27)	(1.25)	(4.72)	(2.63)	(4.69)
ROA	-0.117***	-0.821***	-0.082	-0.598***	-0.058*	-0.358***	-0.128***	-0.700***	-0.124***	-1.067***	-0.175***	-1.029***
	(-4.60)	(-12.42)	(-1.62)	(-4.63)	(-1.72)	(-4.45)	(-3.22)	(-8.56)	(-3.22)	(-10.21)	(-4.13)	(-10.60)
Book leverage	-0.103***	-0.030	-0.148***	-0.366***	-0.115***	-0.038	-0.102***	0.103	-0.072**	-0.020	-0.093***	0.014
	(-5.62)	(-0.49)	(-4.90)	(-4.61)	(-3.13)	(-0.49)	(-3.22)	(1.49)	(-2.39)	(-0.18)	(-3.26)	(0.17)
Constant	1.191***	1.579**	1.303***	1.880	0.741***	0.229	1.035**	1.880***	0.599	1.731***	0.739*	0.895***
	(4.01)	(2.26)	(2.89)	(1.63)	(3.18)	(1.20)	(2.54)	(7.18)	(1.58)	(4.31)	(1.75)	(3.82)
Observations	64,147	44,009	17,344	7,960	6,224	3,786	13,002	9,317	4,735	4,220	22,842	18,726
Adjusted R^2	0.209	0.375	0.203	0.339	0.273	0.309	0.232	0.373	0.188	0.464	0.227	0.432

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel VI: CEO Overconfidence and R&D/Asset (%) (Malmendier and Tate, 2005)

The table presents regression estimates of R&D/Asset on CEO overconfidence. The dependent variable is the ratio of R&D expenditure to total asset. Missing values of R&D are replaced with 0. A CEO is considered overconfident if he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years (Galasso and Simcoe (2011)) or after the first year (Malmendier and Tate (2005)) CEO displays overconfidence if he displayed overconfidence at least twice during the tenure, and 0 otherwise. All independent variables are lagged by 1 year. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. Variable definitions are provided in the Appendix I (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%) Malmendier and Tate (2005)					
	Full sample (January 1993-December 2017)	*Dot com bubble (January 1993-March 2000)*	*Dot com crash (April 2000-September 2002)*	*Post dot com crash (October 2002-September 2007)*	*Global financial crisis (October 2007-June 2009)*	*Post global financial crisis (July 2009-December 2017)*
CEO_MT100	0.064*	0.331***	0.141*	0.064	-0.045	-0.102*
	(1.95)	(5.68)	(1.92)	(1.31)	(-0.64)	(-1.90)
Log(sale)	-0.263***	-0.256***	-0.287***	-0.239***	-0.301***	-0.248***
	(-8.92)	(-6.77)	(-5.14)	(-6.18)	(-6.53)	(-6.20)
Cash	-0.024*	-0.006	-0.043	0.011	-0.061	-0.025
	(-1.75)	(-0.20)	(-1.36)	(0.41)	(-1.53)	(-1.25)
Log (PPE/E)	0.032	0.144***	0.130**	0.126***	-0.077	-0.017
	(0.95)	(2.80)	(2.45)	(3.03)	(-1.35)	(-0.39)
BHAR	-0.056***	-0.060***	-0.060***	-0.030**	-0.065***	-0.075***
	(-8.71)	(-4.41)	(-4.73)	(-2.46)	(-2.76)	(-5.66)
Tobin's Q	0.654***	0.521***	0.484***	0.676***	0.800***	0.813***
	(15.81)	(8.75)	(8.41)	(9.81)	(8.57)	(10.97)
Sales growth	0.139***	0.121***	0.069**	0.143***	0.260***	0.152***
	(10.50)	(6.18)	(2.40)	(6.76)	(5.01)	(7.23)
ROA	-0.718***	-0.668***	-0.590***	-0.711***	-0.925***	-0.804***
	(-13.85)	(-7.93)	(-6.57)	(-8.27)	(-9.32)	(-10.12)
Book leverage	-0.111***	-0.284***	-0.079	-0.036	-0.084	-0.084**
	(-3.78)	(-8.45)	(-1.36)	(-0.91)	(-1.36)	(-2.01)
Constant	1.187***	1.229***	0.675***	1.322***	0.902**	1.263***
	(4.26)	(3.77)	(3.45)	(3.85)	(2.22)	(2.60)

Observations	118,189	29,613	11,357	24,377	9,482	43,360
Adjusted R^2	0.351	0.325	0.354	0.359	0.379	0.393

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel VII: CEO Overconfidence and R&D/Asset (%) for NYSE and NASDAQ-listed firms (Malmendier and Tate, 2005)

The table demonstrates the results of regressions of R&D/Asset on CEO overconfidence with control variables when board is overconfident and when board is non-overconfident. A CEO is considered overconfident if he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years if he displayed overconfidence at least twice during the tenure, and 0 otherwise. While constructing board overconfidence, we only include non-CEO executives. The board if considered overconfident in a year if more than half (method 1) of board members delays the exercise of their stock options. Under this measure, a CEO can have either overconfidence board or non-overconfidence board in different years of his tenure. All independent variables are lagged by 1 year. All continuous independent variables are scaled to have 0 mean and standard deviation of 1. *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable = R&D/Total Assets (%) Malmendier and Tate (2005)											
	Full sample (January 1993-December 2017)		*Dot com bubble (January 1993-March 2000)*		*Dot com crash (April 2000-September 2002)*		*Post dot com crash (October 2002-September 2007)*		*Global financial crisis (October 2007-June 2009)*		*Post global financial crisis (July 2009-December 2017)*	
	NYS	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*	*NYS*	*NAS*
OC_MT100	0.021	0.042	0.094**	0.606***	0.046	0.110	0.049	0.115	-0.018	-0.088	-0.044	-0.237**
	(0.91)	(0.61)	(2.25)	(4.30)	(1.17)	(0.84)	(1.14)	(1.27)	(-0.35)	(-0.67)	(-1.21)	(-2.25)
Log(sale)	0.018	-0.201***	0.065**	-0.216**	0.081**	-0.169*	0.038	-0.177**	-0.002	-0.194**	-0.036	-0.167**
	(0.70)	(-3.28)	(1.99)	(-2.08)	(2.55)	(-1.85)	(1.25)	(-2.35)	(-0.04)	(-2.16)	(-1.01)	(-2.19)
Cash	0.014	-0.037*	0.031	-0.049	0.004	-0.032	-0.020	0.067**	0.087**	-0.125**	0.014	-0.035
	(1.52)	(-1.87)	(1.38)	(-0.97)	(0.15)	(-1.11)	(-1.02)	(2.18)	(2.01)	(-2.55)	(1.23)	(-1.21)
Log (PPE/E)	0.044*	0.073	0.037	0.303*	0.067*	0.141	0.072**	0.108	0.020	-0.068	0.038	0.047
	(1.75)	(1.06)	(0.95)	(1.89)	(1.84)	(1.13)	(2.07)	(1.31)	(0.55)	(-0.65)	(1.36)	(0.58)
BHAR	-0.039***	-0.044***	-0.042***	-0.021	-0.052***	-0.013	-0.022**	-0.032	-0.020	-0.053	-0.050***	-0.088***
	(-7.95)	(-3.69)	(-3.52)	(-0.84)	(-5.23)	(-0.63)	(-2.21)	(-1.51)	(-1.55)	(-1.61)	(-6.47)	(-3.67)
Tobin's Q	0.301***	0.618***	0.273***	0.275***	0.248***	0.317***	0.339***	0.573***	0.275***	0.780***	0.334***	0.903***
	(8.67)	(11.74)	(4.64)	(3.98)	(6.58)	(5.96)	(4.89)	(7.07)	(3.48)	(7.15)	(6.92)	(10.40)

Sales growth	0.013	0.121***	-0.000	0.077**	-0.041***	0.017	0.016	0.109***	0.019	0.234***	0.036***	0.170***
	(1.60)	(5.88)	(-0.01)	(2.27)	(-3.79)	(0.41)	(1.34)	(4.27)	(1.29)	(4.71)	(2.64)	(4.69)
ROA	-0.118***	-0.820***	-0.082	-0.596***	-0.059*	-0.358***	-0.131***	-0.699***	-0.125***	-1.068***	-0.175***	-1.028***
	(-4.63)	(-12.41)	(-1.62)	(-4.63)	(-1.74)	(-4.43)	(-3.30)	(-8.53)	(-3.27)	(-10.21)	(-4.13)	(-10.60)
Book leverage	-0.103***	-0.030	-0.148***	-0.364***	-0.114***	-0.040	-0.102***	0.102	-0.071**	-0.020	-0.093***	0.013
	(-5.62)	(-0.49)	(-4.92)	(-4.68)	(-3.11)	(-0.52)	(-3.22)	(1.47)	(-2.37)	(-0.18)	(-3.25)	(0.17)
Constant	1.185***	1.582**	1.293***	1.921*	0.721***	0.233	1.016**	1.881***	0.584	1.699***	0.737*	0.895***
	(4.01)	(2.27)	(2.85)	(1.68)	(3.02)	(1.21)	(2.53)	(7.15)	(1.58)	(4.31)	(1.75)	(3.82)
Observations	64,147	44,009	17,344	7,960	6,224	3,786	13,002	9,317	4,735	4,220	22,842	18,726
Adjusted R^2	0.209	0.375	0.204	0.340	0.274	0.308	0.233	0.373	0.187	0.464	0.226	0.432

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 16: Alternative explanation of the Effects of Financial Constraints

This table presents the coefficient of CEO overconfidence for regressions analysis of financial constraints. Four measures of financial constraints are used: firm Cash, Leverage, Size and Kaplan-Zingales index. Firms with higher than median of these measures are considered in "high".

Panel I: Cash - Full sample (January 1993-December 2017)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Cash	*Low Cash*	*High Cash*	*Low Cash*	*High Cash*	*Low Cash*
CEO_GS67	0.055	0.075*	-0.010	-0.023	0.062	0.096
	(1.39)	(1.72)	(-0.30)	(-0.66)	(0.73)	(0.95)
Log(sale)	-0.221***	-0.224***	0.026	0.031	-0.131**	-0.166**
	(-8.15)	(-7.42)	(0.98)	(1.12)	(-2.30)	(-2.52)
Cash	0.175***	-0.278***	0.097***	-0.097***	0.145***	-0.305***
	(7.58)	(-7.96)	(5.26)	(-4.44)	(4.35)	(-6.06)
Log (PPE/E)	0.008	0.068*	0.038	0.051*	0.012	0.146**
	(0.22)	(1.90)	(1.54)	(1.86)	(0.16)	(2.08)
BHAR	-0.054***	-0.052***	-0.045***	-0.029***	-0.031**	-0.052***
	(-6.64)	(-5.37)	(-6.56)	(-4.68)	(-2.38)	(-2.74)
Tobin's Q	0.556***	0.686***	0.283***	0.296***	0.537***	0.641***
	(14.75)	(14.30)	(7.81)	(8.11)	(10.89)	(10.40)
Sales growth	0.138***	0.112***	0.004	0.013	0.157***	0.057**
	(8.31)	(7.04)	(0.44)	(1.44)	(6.34)	(2.10)
ROA	-0.647***	-0.740***	-0.094***	-0.132***	-0.783***	-0.816***
	(-12.57)	(-13.21)	(-3.33)	(-4.93)	(-11.43)	(-11.32)
Book leverage	-0.125***	-0.077**	-0.096***	-0.095***	-0.058	-0.009
	(-4.91)	(-2.07)	(-4.96)	(-5.12)	(-1.11)	(-0.12)
Constant	1.387***	0.714***	1.374***	0.938***	3.056	0.354
	(4.00)	(2.79)	(4.11)	(3.43)	(1.27)	(0.67)
Observations	58,746	59,443	31,514	32,633	22,470	21,539
Adjusted R^2	0.351	0.364	0.218	0.206	0.376	0.386

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel II: Cash - Dot com bubble (January 1993-March 2000)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Cash	*Low Cash*	*High Cash*	*Low Cash*	*High Cash*	*Low Cash*
CEO_GS67	0.331***	0.336***	0.032	0.068	0.881***	0.926***
	(4.81)	(5.87)	(0.57)	(1.46)	(4.68)	(4.94)
Log(sale)	-0.246***	-0.219***	0.078**	0.071**	-0.115	-0.169
	(-5.45)	(-5.55)	(2.13)	(2.00)	(-1.10)	(-1.50)
Cash	0.077*	-0.202***	0.108***	-0.099**	-0.015	-0.294***
	(1.71)	(-3.55)	(2.67)	(-2.32)	(-0.18)	(-2.80)
Log (PPE/E)	0.116*	0.178***	0.043	0.029	0.258	0.393***
	(1.85)	(3.32)	(1.07)	(0.64)	(1.25)	(2.88)
BHAR	-0.062***	-0.064***	-0.058***	-0.026**	-0.016	-0.040
	(-3.57)	(-3.14)	(-3.40)	(-2.01)	(-0.56)	(-0.96)
Tobin's Q	0.470***	0.557***	0.283***	0.241***	0.281***	0.243***
	(7.35)	(7.85)	(4.04)	(4.47)	(3.28)	(3.35)
Sales growth	0.119***	0.103***	-0.017	0.002	0.082*	0.047
	(3.72)	(3.98)	(-0.92)	(0.12)	(1.82)	(0.96)
ROA	-0.646***	-0.664***	-0.026	-0.114**	-0.685***	-0.496***
	(-5.94)	(-8.46)	(-0.43)	(-2.26)	(-3.83)	(-4.46)
Book leverage	-0.305***	-0.244***	-0.147***	-0.127***	-0.395***	-0.365***
	(-7.51)	(-6.71)	(-4.35)	(-3.84)	(-4.16)	(-4.51)
Constant	1.648***	0.542**	1.631***	0.871**	2.912	0.235
	(3.07)	(2.12)	(3.39)	(2.09)	(0.99)	(0.46)
Observations	14,641	14,972	8,486	8,858	4,070	3,890
Adjusted R^2	0.316	0.337	0.214	0.195	0.332	0.361

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel III: Cash - Dot com crash (April 2000-September 2002)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Cash	*Low Cash*	*High Cash*	*Low Cash*	*High Cash*	*Low Cash*
CEO_GS67	0.102	0.099	0.074	-0.070	0.209	0.144
	(1.23)	(1.10)	(1.38)	(-1.15)	(1.00)	(0.88)
Log(sale)	-0.228***	-0.275***	0.084**	0.080**	-0.078	-0.191*
	(-4.39)	(-4.05)	(2.35)	(2.17)	(-0.71)	(-1.91)
Cash	0.130***	-0.243***	0.066*	-0.097	0.102*	-0.076
	(2.65)	(-3.95)	(1.78)	(-1.45)	(1.71)	(-0.96)
Log (PPE/E)	0.118*	0.143**	0.061	0.071*	0.114	0.164
	(1.79)	(2.50)	(1.43)	(1.80)	(0.70)	(1.30)
BHAR	-0.049***	-0.066***	-0.066***	-0.038**	-0.002	-0.026
	(-2.92)	(-3.28)	(-4.12)	(-2.40)	(-0.08)	(-0.96)
Tobin's Q	0.432***	0.496***	0.236***	0.264***	0.299***	0.301***
	(7.38)	(7.44)	(6.39)	(5.83)	(4.71)	(5.00)
Sales growth	0.059	0.052*	-0.051***	-0.034**	0.030	-0.002
	(1.02)	(1.83)	(-3.27)	(-2.40)	(0.39)	(-0.05)
ROA	-0.465***	-0.651***	-0.067*	-0.044	-0.199*	-0.487***
	(-4.93)	(-6.71)	(-1.78)	(-1.09)	(-1.75)	(-5.54)
Book leverage	-0.113*	-0.021	-0.106**	-0.101***	-0.156	0.034
	(-1.93)	(-0.32)	(-2.43)	(-2.63)	(-1.61)	(0.38)
Constant	0.691**	0.445***	0.724***	0.445***	0.352	0.502*
	(2.44)	(3.64)	(2.78)	(2.63)	(1.00)	(1.87)
Observations	5,545	5,812	2,994	3,230	1,896	1,890
Adjusted R^2	0.319	0.396	0.295	0.253	0.250	0.390

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel IV: Cash - Post dot com crash (October 2002-September 2007)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Cash	*Low Cash*	*High Cash*	*Low Cash*	*High Cash*	*Low Cash*
CEO_GS67	-0.034	-0.004	-0.047	-0.049	0.032	0.126
	(-0.56)	(-0.05)	(-0.81)	(-0.59)	(0.30)	(1.18)
Log(sale)	-0.222***	-0.179***	0.037	0.053	-0.155*	-0.120
	(-6.14)	(-4.57)	(1.19)	(1.64)	(-1.87)	(-1.51)
Cash	0.213***	-0.259***	0.060**	-0.143***	0.187***	-0.156***
	(5.29)	(-4.68)	(2.52)	(-3.17)	(3.33)	(-3.17)
Log (PPE/E)	0.074	0.200***	0.060*	0.093**	-0.031	0.266***
	(1.57)	(4.47)	(1.77)	(2.33)	(-0.31)	(3.19)
BHAR	-0.040**	-0.020	-0.036**	-0.006	-0.033	-0.026
	(-2.15)	(-1.14)	(-2.07)	(-0.36)	(-1.08)	(-0.81)
Tobin's Q	0.545***	0.723***	0.282***	0.375***	0.480***	0.607***
	(10.39)	(8.10)	(3.88)	(5.22)	(6.55)	(5.86)
Sales growth	0.155***	0.106***	0.012	0.014	0.174***	0.022
	(6.49)	(4.05)	(0.71)	(0.92)	(4.63)	(0.72)
ROA	-0.605***	-0.752***	-0.071*	-0.173***	-0.666***	-0.691***
	(-9.84)	(-6.72)	(-1.77)	(-3.57)	(-8.00)	(-6.59)
Book leverage	-0.065*	-0.000	-0.090**	-0.101***	0.060	0.112
	(-1.69)	(-0.00)	(-2.44)	(-3.13)	(0.86)	(1.32)
Constant	1.275**	0.367	1.477**	0.812***	1.621***	0.977***
	(2.16)	(0.83)	(2.48)	(2.74)	(4.95)	(4.25)
Observations	12,136	12,241	6,416	6,586	4,762	4,555
Adjusted R^2	0.362	0.373	0.226	0.245	0.367	0.389

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel V: Cash - Global financial crisis (October 2007-June 2009)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Cash	*Low Cash*	*High Cash*	*Low Cash*	*High Cash*	*Low Cash*
CEO_GS67	-0.276*	-0.076	-0.119	-0.099	-0.276*	-0.100
	(-1.70)	(-0.66)	(-1.28)	(-1.56)	(-1.70)	(-0.49)
Log(sale)	-0.170*	-0.231***	0.021	0.007	-0.170*	-0.052
	(-1.85)	(-4.88)	(0.45)	(0.15)	(-1.85)	(-0.50)
Cash	0.214***	-0.456***	0.279***	-0.028	0.214***	-0.520***
	(3.33)	(-5.81)	(2.86)	(-0.60)	(3.33)	(-5.27)
Log (PPE/E)	-0.209*	-0.035	0.005	0.025	-0.209*	0.100
	(-1.79)	(-0.50)	(0.11)	(0.63)	(-1.79)	(0.79)
BHAR	-0.066*	-0.026	-0.018	-0.017	-0.066*	-0.027
	(-1.83)	(-0.80)	(-1.06)	(-0.78)	(-1.83)	(-0.47)
Tobin's Q	0.632***	0.877***	0.146**	0.370***	0.632***	0.807***
	(6.54)	(6.34)	(2.52)	(3.29)	(6.54)	(4.94)
Sales growth	0.225***	0.261***	-0.007	0.039*	0.225***	0.197***
	(3.86)	(3.97)	(-0.35)	(1.87)	(3.86)	(2.90)
ROA	-0.937***	-0.974***	-0.101**	-0.149***	-0.937***	-1.120***
	(-8.13)	(-8.21)	(-2.12)	(-3.22)	(-8.13)	(-8.25)
Book leverage	0.023	-0.029	-0.072*	-0.028	0.023	-0.020
	(0.19)	(-0.40)	(-1.92)	(-0.91)	(0.19)	(-0.16)
Constant	0.769***	0.256*	0.699	0.478***	0.769***	0.156
	(2.91)	(1.81)	(1.26)	(3.19)	(2.91)	(0.54)
Observations	2,097	4,870	2,282	2,453	2,097	2,123
Adjusted R^2	0.520	0.393	0.190	0.205	0.520	0.452

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel VI: Cash - Post global financial crisis (July 2009-December 2017)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Cash	*Low Cash*	*High Cash*	*Low Cash*	*High Cash*	*Low Cash*
CEO_GS67	-0.069	-0.051	-0.039	-0.069	-0.168	-0.159
	(-1.16)	(-0.70)	(-0.83)	(-1.20)	(-1.52)	(-1.05)
Log(sale)	-0.201***	-0.210***	-0.033	-0.017	-0.095	-0.132
	(-5.50)	(-5.16)	(-0.98)	(-0.45)	(-1.35)	(-1.56)
Cash	0.191***	-0.266***	0.100***	-0.085***	0.182***	-0.314***
	(5.21)	(-4.56)	(3.66)	(-3.31)	(3.46)	(-3.66)
Log (PPE/E)	-0.037	0.011	0.028	0.044	0.014	0.089
	(-0.85)	(0.24)	(0.97)	(1.45)	(0.18)	(0.98)
BHAR	-0.061***	-0.081***	-0.043***	-0.053***	-0.060**	-0.106***
	(-4.01)	(-4.05)	(-4.36)	(-5.41)	(-2.33)	(-2.77)
Tobin's Q	0.704***	0.842***	0.323***	0.315***	0.781***	0.937***
	(9.67)	(10.35)	(6.67)	(5.93)	(9.14)	(9.78)
Sales growth	0.169***	0.112***	0.034**	0.032**	0.227***	0.084*
	(6.00)	(4.28)	(2.34)	(2.17)	(4.96)	(1.68)
ROA	-0.749***	-0.824***	-0.176***	-0.167***	-0.995***	-1.032***
	(-9.42)	(-9.56)	(-4.02)	(-3.79)	(-10.24)	(-9.70)
Book leverage	-0.086**	-0.067	-0.078***	-0.099***	-0.018	0.043
	(-2.34)	(-1.27)	(-2.88)	(-3.12)	(-0.24)	(0.43)
Constant	0.688*	0.898*	0.677*	0.915**	0.432*	0.840***
	(1.69)	(1.95)	(1.85)	(1.97)	(1.80)	(2.90)
Observations	21,812	21,548	11,336	11,506	9,645	9,081
Adjusted R^2	0.408	0.393	0.247	0.213	0.450	0.427

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel VII: Leverage - Full sample (January 1993-December 2017)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Leverage	*Low Leverage*	*High Leverage*	*Low Leverage*	*High Leverage*	*Low Leverage*
CEO_GS67	-0.002	0.127**	-0.054	0.018	-0.000	0.156
	(-0.05)	(2.34)	(-1.49)	(0.42)	(-0.00)	(1.44)
Log(sale)	-0.259***	-0.240***	0.054*	-0.017	-0.207**	-0.163**
	(-6.51)	(-7.16)	(1.79)	(-0.55)	(-2.54)	(-2.27)
Cash	-0.056**	0.001	0.006	0.026**	-0.072**	-0.014
	(-2.45)	(0.08)	(0.45)	(2.31)	(-2.07)	(-0.62)
Log (PPE/E)	0.038	0.043	0.065**	0.022	0.038	0.119
	(1.02)	(0.97)	(2.35)	(0.67)	(0.48)	(1.37)
BHAR	-0.053***	-0.058***	-0.032***	-0.047***	-0.049***	-0.040**
	(-6.44)	(-5.97)	(-5.67)	(-5.77)	(-2.87)	(-2.49)
Tobin's Q	0.804***	0.550***	0.352***	0.255***	0.755***	0.535***
	(12.58)	(12.97)	(7.06)	(6.95)	(9.49)	(9.84)
Sales growth	0.105***	0.169***	0.001	0.026**	0.052**	0.164***
	(6.21)	(9.75)	(0.13)	(2.15)	(2.05)	(6.19)
ROA	-0.676***	-0.743***	-0.077***	-0.148***	-0.764***	-0.848***
	(-9.25)	(-12.73)	(-2.69)	(-4.25)	(-9.08)	(-10.74)
Book leverage	-0.102***	-0.281***	-0.123***	-0.167***	0.006	-0.214***
	(-2.72)	(-7.57)	(-4.66)	(-4.69)	(0.08)	(-3.08)
Constant	1.163***	1.147***	0.998***	1.385***	1.046**	1.288
	(3.61)	(3.84)	(3.04)	(4.53)	(2.48)	(1.48)
Observations	57,875	60,314	34,817	29,330	17,751	26,258
Adjusted R^2	0.328	0.373	0.212	0.223	0.375	0.382

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel VIII: Leverage - Dot com bubble (January 1993-March 2000)

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
			NYS Exchange		*NASDAQ Exchange*	
	High Leverage	*Low Leverage*	*High Leverage*	*Low Leverage*	*High Leverage*	*Low Leverage*
CEO_GS67	0.266***	0.358***	0.074	-0.009	0.661***	1.022***
	(4.57)	(4.19)	(1.63)	(-0.12)	(2.68)	(4.67)
Log(sale)	-0.251***	-0.229***	0.064	0.057	-0.241**	-0.133
	(-4.99)	(-4.69)	(1.61)	(1.39)	(-2.26)	(-0.99)
Cash	0.009	-0.020	0.008	0.054**	-0.022	-0.068
	(0.18)	(-0.56)	(0.23)	(1.98)	(-0.21)	(-1.22)
Log (PPE/E)	0.157***	0.148**	0.055	0.030	0.218	0.351*
	(3.02)	(1.98)	(1.33)	(0.55)	(1.19)	(1.75)
BHAR	-0.062***	-0.064***	-0.046***	-0.041**	-0.030	-0.028
	(-4.60)	(-2.80)	(-3.34)	(-2.06)	(-1.04)	(-0.76)
Tobin's Q	0.606***	0.490***	0.381***	0.196***	0.209**	0.303***
	(9.98)	(6.43)	(5.48)	(2.78)	(2.45)	(3.39)
Sales growth	0.057***	0.173***	0.002	-0.002	-0.037	0.127***
	(2.67)	(5.96)	(0.14)	(-0.11)	(-0.73)	(2.96)
ROA	-0.483***	-0.790***	-0.073	-0.090	-0.412***	-0.691***
	(-6.19)	(-7.16)	(-1.33)	(-1.22)	(-3.68)	(-4.13)
Book leverage	-0.302***	-0.419***	-0.202***	-0.268***	-0.483***	-0.497***
	(-6.38)	(-6.95)	(-4.76)	(-4.86)	(-4.75)	(-3.10)
Constant	1.290***	1.012**	1.138**	1.675***	2.176***	0.950
	(3.11)	(2.45)	(2.15)	(5.82)	(4.79)	(0.65)
Observations	14,528	15,085	9,227	8,117	3,138	4,822
Adjusted R^2	0.273	0.355	0.203	0.231	0.336	0.350

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel IX: Leverage - Dot com crash (April 2000-September 2002)

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
			NYS Exchange		*NASDAQ Exchange*	
	High Leverage	*Low Leverage*	*High Leverage*	*Low Leverage*	*High Leverage*	*Low Leverage*
CEO_GS67	0.016	0.181*	-0.074	0.061	0.049	0.271
	(0.16)	(1.65)	(-1.21)	(0.97)	(0.23)	(1.29)
Log(sale)	-0.309***	-0.196***	0.059	0.091**	-0.175	-0.113
	(-4.22)	(-2.61)	(1.38)	(2.05)	(-1.30)	(-0.91)
Cash	-0.116**	-0.000	-0.011	0.021	-0.071*	-0.010
	(-1.98)	(-0.01)	(-0.26)	(0.90)	(-1.89)	(-0.24)
Log (PPE/E)	0.059	0.226***	0.112**	0.014	0.064	0.235
	(0.98)	(2.66)	(2.51)	(0.26)	(0.49)	(1.20)
BHAR	-0.085***	-0.026	-0.062***	-0.044***	-0.046*	0.022
	(-4.75)	(-1.45)	(-4.45)	(-2.96)	(-1.68)	(0.75)
Tobin's Q	0.677***	0.330***	0.333***	0.191***	0.303***	0.296***
	(6.65)	(6.85)	(4.97)	(5.55)	(3.56)	(4.80)
Sales growth	0.077*	0.057	-0.028**	-0.051***	0.016	0.026
	(1.70)	(1.49)	(-2.10)	(-3.04)	(0.43)	(0.39)
ROA	-0.731***	-0.454***	-0.081*	-0.049	-0.450***	-0.313***
	(-4.80)	(-5.27)	(-1.71)	(-1.05)	(-4.06)	(-2.92)
Book leverage	-0.076	-0.433***	-0.137***	-0.258***	-0.040	-0.446**
	(-1.28)	(-6.00)	(-2.67)	(-3.93)	(-0.38)	(-2.20)
Constant	0.658***	0.640***	0.448***	0.885***	0.559	1.374**
	(3.84)	(2.88)	(4.25)	(5.92)	(1.64)	(2.20)
Observations	5,639	5,718	3,398	2,826	1,552	2,234
Adjusted R^2	0.413	0.326	0.292	0.279	0.408	0.270

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel X: Leverage - Post dot com crash (October 2002-September 2007)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Leverage	*Low Leverage*	*High Leverage*	*Low Leverage*	*High Leverage*	*Low Leverage*
CEO_GS67	-0.115	0.098	-0.141	0.025	0.023	0.146
	(-1.19)	(1.43)	(-1.46)	(0.35)	(0.16)	(1.31)
Log(sale)	-0.275***	-0.175***	0.048	0.009	-0.141	-0.161*
	(-4.62)	(-4.00)	(1.17)	(0.23)	(-1.20)	(-1.86)
Cash	-0.061	0.080***	-0.024	-0.010	0.035	0.102***
	(-1.17)	(3.60)	(-0.70)	(-0.54)	(0.51)	(3.51)
Log (PPE/E)	0.146***	0.115**	0.107**	0.030	0.155	0.107
	(2.58)	(1.98)	(2.09)	(0.70)	(1.40)	(0.96)
BHAR	-0.021	-0.033**	-0.008	-0.036**	-0.035	-0.034
	(-1.07)	(-2.06)	(-0.66)	(-2.41)	(-0.91)	(-1.26)
Tobin's Q	0.872***	0.485***	0.486***	0.248***	0.680***	0.475***
	(7.66)	(7.67)	(3.68)	(4.49)	(4.76)	(5.74)
Sales growth	0.107***	0.168***	0.017	0.025	0.009	0.184***
	(3.68)	(7.16)	(1.19)	(1.37)	(0.30)	(5.10)
ROA	-0.802***	-0.588***	-0.192***	-0.081*	-0.663***	-0.699***
	(-5.65)	(-8.29)	(-3.46)	(-1.65)	(-4.66)	(-8.48)
Book leverage	-0.052	-0.302***	-0.118***	-0.189***	0.137	-0.207**
	(-0.88)	(-5.47)	(-2.80)	(-2.91)	(1.55)	(-2.04)
Constant	0.433**	1.213***	0.692***	1.382***	0.085	1.534***
	(2.44)	(7.54)	(4.19)	(6.23)	(0.18)	(5.87)
Observations	11,919	12,458	6,930	6,072	3,805	5,512
Adjusted R^2	0.349	0.401	0.243	0.242	0.337	0.433

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XI: Leverage - Global financial crisis (October 2007-June 2009)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Leverage	*Low Leverage*	*High Leverage*	*Low Leverage*	*High Leverage*	*Low Leverage*
CEO_GS67	-0.140	-0.066	-0.152*	-0.050	-0.140	-0.146
	(-0.50)	(-0.57)	(-1.78)	(-0.51)	(-0.50)	(-0.81)
Log(sale)	-0.230*	-0.231***	0.057	-0.061	-0.230*	-0.106
	(-1.77)	(-3.98)	(0.91)	(-1.37)	(-1.77)	(-0.93)
Cash	-0.173**	-0.057	0.091	0.099**	-0.173**	-0.099*
	(-2.16)	(-1.15)	(1.23)	(2.02)	(-2.16)	(-1.69)
Log (PPE/E)	-0.160	-0.090	0.064	-0.015	-0.160	0.014
	(-1.22)	(-1.06)	(1.40)	(-0.29)	(-1.22)	(0.09)
BHAR	-0.101**	-0.045	-0.014	-0.023	-0.101**	-0.018
	(-2.47)	(-1.43)	(-0.83)	(-1.45)	(-2.47)	(-0.37)
Tobin's Q	0.841***	0.702***	0.305***	0.229**	0.841***	0.705***
	(4.01)	(7.20)	(3.94)	(2.26)	(4.01)	(6.23)
Sales growth	0.129*	0.270***	0.017	0.016	0.129*	0.309***
	(1.75)	(6.88)	(0.92)	(0.69)	(1.75)	(5.81)
ROA	-1.065***	-0.922***	-0.099*	-0.139***	-1.065***	-1.086***
	(-5.91)	(-10.05)	(-1.85)	(-3.19)	(-5.91)	(-9.57)
Book leverage	0.186	-0.327***	-0.124**	-0.068	0.186	-0.436***
	(1.08)	(-3.75)	(-2.53)	(-0.88)	(1.08)	(-3.00)
Constant	1.028**	1.155**	0.388***	1.052**	1.028**	0.932***
	(2.30)	(2.56)	(4.00)	(2.19)	(2.30)	(3.84)
Observations	1,728	4,803	2,654	2,081	1,728	2,492
Adjusted R^2	0.486	0.418	0.194	0.198	0.486	0.454

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XII: Leverage - Post global financial crisis (July 2009-December 2017)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Leverage	*Low Leverage*	*High Leverage*	*Low Leverage*	*High Leverage*	*Low Leverage*
CEO_GS67	-0.118	-0.014	-0.108*	0.007	-0.244	-0.072
	(-1.52)	(-0.16)	(-1.86)	(0.09)	(-1.26)	(-0.48)
Log(sale)	-0.199***	-0.269***	0.046	-0.104**	-0.154	-0.148*
	(-3.52)	(-5.62)	(1.28)	(-2.15)	(-1.33)	(-1.67)
Cash	-0.055**	-0.001	0.016	0.012	-0.095**	0.003
	(-1.98)	(-0.04)	(1.18)	(0.68)	(-2.27)	(0.10)
Log (PPE/E)	0.001	-0.027	0.051	0.026	0.037	0.076
	(0.02)	(-0.46)	(1.49)	(0.66)	(0.33)	(0.74)
BHAR	-0.056***	-0.096***	-0.033***	-0.068***	-0.073**	-0.099***
	(-3.52)	(-4.33)	(-4.28)	(-5.09)	(-2.22)	(-2.84)
Tobin's Q	0.931***	0.714***	0.277***	0.348***	1.097***	0.780***
	(8.21)	(9.49)	(4.35)	(5.39)	(8.29)	(8.45)
Sales growth	0.124***	0.175***	0.003	0.064***	0.119***	0.199***
	(5.39)	(5.85)	(0.17)	(3.05)	(2.60)	(4.23)
ROA	-0.716***	-0.864***	-0.052	-0.266***	-0.963***	-1.069***
	(-6.77)	(-9.15)	(-1.10)	(-4.29)	(-7.71)	(-8.95)
Book leverage	-0.064	-0.168***	-0.088**	-0.126***	0.068	-0.067
	(-1.09)	(-3.25)	(-2.07)	(-2.77)	(0.53)	(-0.68)
Constant	1.338***	0.783	0.737*	0.869*	1.067***	0.770***
	(2.64)	(1.41)	(1.66)	(1.69)	(4.23)	(3.06)
Observations	21,110	22,250	12,608	10,234	7,528	11,198
Adjusted R^2	0.367	0.415	0.230	0.251	0.440	0.434

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XIII: Size - Full sample (January 1993-December 2017)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Size	*Low Size*	*High Size*	*Low Size*	*High Size*	*Low Size*
CEO_GS67	0.021	0.097	-0.061	0.061	0.234**	-0.031
	(0.50)	(1.55)	(-1.50)	(1.35)	(2.16)	(-0.26)
Log(sale)	-0.141***	-0.587***	0.022	-0.148***	-0.157*	-0.460***
	(-3.94)	(-9.28)	(0.58)	(-3.70)	(-1.70)	(-3.80)
Cash	-0.004	-0.028	0.027*	0.002	-0.050	-0.032
	(-0.23)	(-1.58)	(1.68)	(0.23)	(-1.62)	(-1.38)
Log (PPE/E)	0.222***	-0.124***	0.072**	-0.017	0.338***	-0.086
	(5.54)	(-2.82)	(2.22)	(-0.49)	(3.30)	(-1.11)
BHAR	-0.038***	-0.059***	-0.041***	-0.033***	-0.010	-0.057***
	(-6.08)	(-6.18)	(-6.25)	(-4.95)	(-0.71)	(-3.57)
Tobin's Q	0.501***	0.595***	0.322***	0.222***	0.505***	0.586***
	(9.45)	(12.27)	(7.37)	(4.74)	(6.05)	(9.75)
Sales growth	0.049***	0.162***	-0.000	0.028**	0.048*	0.133***
	(3.56)	(9.58)	(-0.02)	(2.45)	(1.80)	(5.20)
ROA	-0.247***	-0.780***	-0.076**	-0.126***	-0.352***	-0.864***
	(-5.47)	(-14.26)	(-2.46)	(-3.55)	(-4.14)	(-12.20)
Book leverage	-0.139***	-0.057	-0.088***	-0.102***	-0.075	0.026
	(-4.98)	(-1.28)	(-3.77)	(-4.46)	(-1.12)	(0.31)
Constant	1.525***	0.462**	1.428***	0.836***	4.335	0.814
	(5.05)	(2.52)	(3.81)	(2.78)	(.)	(1.27)
Observations	60,165	58,024	40,156	23,991	16,317	27,692
Adjusted R^2	0.269	0.408	0.226	0.201	0.298	0.415

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XIV: Size - Dot com bubble (January 1993-March 2000)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Size	*Low Size*	*High Size*	*Low Size*	*High Size*	*Low Size*
CEO_GS67	0.154**	0.473***	-0.029	0.150***	1.016***	0.774***
	(2.47)	(5.53)	(-0.48)	(2.97)	(3.83)	(3.90)
Log(sale)	-0.128***	-0.619***	0.057	-0.138**	-0.307*	-0.344
	(-2.60)	(-7.76)	(1.14)	(-2.51)	(-1.89)	(-1.48)
Cash	0.012	-0.016	0.078*	-0.010	-0.112	-0.030
	(0.34)	(-0.43)	(1.76)	(-0.41)	(-1.51)	(-0.50)
Log (PPE/E)	0.302***	-0.049	0.065	-0.028	0.817***	-0.106
	(4.98)	(-0.68)	(1.26)	(-0.53)	(4.94)	(-0.53)
BHAR	-0.032**	-0.077***	-0.046***	-0.031**	0.018	-0.045
	(-2.48)	(-3.54)	(-2.70)	(-2.24)	(0.68)	(-1.27)
Tobin's Q	0.371***	0.437***	0.330***	0.144*	0.225***	0.222***
	(6.77)	(5.72)	(4.26)	(1.91)	(2.89)	(2.74)
Sales growth	0.034*	0.143***	0.003	0.007	0.005	0.081*
	(1.67)	(5.86)	(0.18)	(0.32)	(0.09)	(1.94)
ROA	-0.118**	-0.739***	-0.055	-0.068	-0.129	-0.693***
	(-2.20)	(-8.04)	(-0.96)	(-0.87)	(-1.12)	(-4.55)
Book leverage	-0.257***	-0.240***	-0.170***	-0.109***	-0.243**	-0.415***
	(-6.64)	(-5.40)	(-3.85)	(-3.59)	(-2.24)	(-3.99)
Constant	1.337***	0.478	1.241***	1.542***	0.550	0.619
	(3.74)	(0.92)	(2.88)	(5.69)	(1.07)	(0.45)
Observations	15,329	14,284	10,663	6,681	2,986	4,974
Adjusted R^2	0.274	0.382	0.222	0.177	0.347	0.369

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XV: Size - Dot com crash (April 2000-September 2002)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Size	*Low Size*	*High Size*	*Low Size*	*High Size*	*Low Size*
CEO_GS67	0.028	0.180	-0.048	0.095	0.458*	-0.089
	(0.36)	(1.31)	(-0.70)	(1.51)	(1.90)	(-0.42)
Log(sale)	-0.130**	-0.744***	0.064	-0.097**	-0.355**	-0.404*
	(-2.48)	(-5.14)	(1.33)	(-1.99)	(-2.45)	(-1.88)
Cash	-0.003	-0.047	0.012	0.008	-0.007	-0.037
	(-0.08)	(-1.16)	(0.30)	(0.31)	(-0.15)	(-1.05)
Log (PPE/E)	0.338***	-0.044	0.142***	-0.021	0.556***	-0.132
	(5.33)	(-0.58)	(2.86)	(-0.38)	(3.14)	(-0.91)
BHAR	-0.045***	-0.050***	-0.060***	-0.041**	0.021	-0.016
	(-3.30)	(-2.71)	(-4.50)	(-2.52)	(0.62)	(-0.62)
Tobin's Q	0.399***	0.409***	0.276***	0.182***	0.285***	0.265***
	(7.37)	(6.17)	(6.52)	(3.29)	(3.03)	(4.60)
Sales growth	0.018	0.081**	-0.037**	-0.029**	0.001	0.029
	(0.44)	(2.28)	(-2.39)	(-2.20)	(0.01)	(0.77)
ROA	-0.210***	-0.622***	-0.070	-0.007	-0.032	-0.447***
	(-3.47)	(-6.66)	(-1.59)	(-0.16)	(-0.22)	(-5.22)
Book leverage	-0.186***	0.026	-0.153***	-0.063	-0.056	-0.005
	(-3.42)	(0.32)	(-3.38)	(-1.28)	(-0.42)	(-0.05)
Constant	0.952***	0.270**	0.778***	0.583**	0.097	-0.185
	(5.20)	(2.51)	(2.67)	(2.05)	(0.35)	(-0.42)
Observations	5,739	5,618	3,828	2,396	1,443	2,343
Adjusted R^2	0.278	0.429	0.300	0.230	0.232	0.388

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XVI: Size - Post dot com crash (October 2002-September 2007)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Size	*Low Size*	*High Size*	*Low Size*	*High Size*	*Low Size*
CEO_GS67	-0.114	0.052	-0.104	0.068	-0.058	0.073
	(-1.45)	(0.52)	(-1.02)	(1.23)	(-0.37)	(0.64)
Log(sale)	-0.133***	-0.615***	0.001	-0.168***	-0.144	-0.452***
	(-3.03)	(-6.71)	(0.03)	(-3.72)	(-1.27)	(-3.09)
Cash	0.024	0.005	-0.016	-0.022	0.080	0.054*
	(0.66)	(0.15)	(-0.49)	(-1.29)	(0.94)	(1.70)
Log (PPE/E)	0.247***	0.025	0.098*	0.017	0.312**	-0.000
	(4.94)	(0.41)	(1.78)	(0.43)	(2.59)	(-0.00)
BHAR	-0.020	-0.026	-0.021	-0.019	-0.022	-0.038
	(-1.41)	(-1.47)	(-1.51)	(-1.32)	(-0.71)	(-1.49)
Tobin's Q	0.468***	0.631***	0.342***	0.255***	0.394***	0.558***
	(5.26)	(7.98)	(3.85)	(3.17)	(2.89)	(6.16)
Sales growth	0.028	0.176***	-0.002	0.041**	-0.035	0.142***
	(1.52)	(6.99)	(-0.10)	(2.57)	(-0.94)	(4.75)
ROA	-0.239***	-0.755***	-0.079	-0.127**	-0.159	-0.745***
	(-4.16)	(-8.13)	(-1.43)	(-2.44)	(-1.44)	(-8.18)
Book leverage	-0.095**	0.024	-0.115***	-0.055	0.133	0.122
	(-1.99)	(0.44)	(-2.82)	(-1.29)	(1.33)	(1.40)
Constant	1.449***	0.599***	1.750***	0.845*	0.560*	2.123***
	(11.53)	(3.33)	(11.67)	(1.71)	(1.81)	(6.90)
Observations	12,288	12,089	8,157	4,845	3,323	5,994
Adjusted R^2	0.247	0.448	0.237	0.261	0.245	0.458

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XVII: Size - Global financial crisis (October 2007-June 2009)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Size	*Low Size*	*High Size*	*Low Size*	*High Size*	*Low Size*
CEO_GS67	0.043	-0.190	-0.164*	-0.037	0.043	-0.340
	(0.25)	(-1.15)	(-1.92)	(-0.35)	(0.25)	(-1.47)
Log(sale)	-0.003	-0.746***	-0.007	-0.170**	-0.003	-0.686***
	(-0.02)	(-6.09)	(-0.14)	(-2.42)	(-0.02)	(-3.55)
Cash	-0.191***	-0.064	0.156**	0.026	-0.191***	-0.105*
	(-3.05)	(-1.31)	(2.26)	(0.67)	(-3.05)	(-1.88)
Log (PPE/E)	0.247*	-0.234***	-0.001	0.009	0.247*	-0.231*
	(1.84)	(-2.71)	(-0.02)	(0.14)	(1.84)	(-1.67)
BHAR	-0.113	-0.055	-0.011	-0.013	-0.113	-0.023
	(-1.59)	(-1.64)	(-0.70)	(-0.70)	(-1.59)	(-0.63)
Tobin's Q	0.446***	0.762***	0.242***	0.199	0.446***	0.793***
	(2.79)	(6.73)	(3.78)	(1.62)	(2.79)	(6.26)
Sales growth	0.062	0.305***	0.026	0.004	0.062	0.263***
	(1.03)	(4.01)	(1.13)	(0.19)	(1.03)	(4.30)
ROA	-0.557***	-0.943***	-0.096*	-0.108**	-0.557***	-1.002***
	(-3.94)	(-8.26)	(-1.69)	(-2.43)	(-3.94)	(-8.52)
Book leverage	-0.212*	0.036	-0.046	-0.069**	-0.212*	0.154
	(-1.96)	(0.34)	(-1.14)	(-2.01)	(-1.96)	(0.94)
Constant	0.870**	0.432	1.587***	0.284	0.870**	1.675***
	(2.45)	(1.63)	(12.87)	(1.61)	(2.45)	(4.27)
Observations	1,509	4,739	3,051	1,684	1,509	2,711
Adjusted R^2	0.275	0.444	0.203	0.193	0.275	0.526

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XVIII: Size - Post global financial crisis (July 2009-December 2017)

	Dependent Variable = R&D/Total Assets (%) *Galasso and Simcoe (2011)*					
			NYS Exchange		*NASDAQ Exchange*	
	High Size	*Low Size*	*High Size*	*Low Size*	*High Size*	*Low Size*
CEO_GS67	-0.030	-0.101	-0.078	-0.012	0.127	-0.331*
	(-0.52)	(-0.96)	(-1.28)	(-0.14)	(0.99)	(-1.87)
Log(sale)	-0.119**	-0.521***	0.006	-0.196***	-0.062	-0.370**
	(-2.57)	(-5.46)	(0.14)	(-2.83)	(-0.53)	(-2.31)
Cash	-0.012	-0.023	0.007	0.025	-0.042	-0.029
	(-0.61)	(-0.87)	(0.51)	(1.46)	(-1.09)	(-0.84)
Log (PPE/E)	0.177***	-0.171***	0.053	-0.033	0.211*	-0.058
	(3.81)	(-2.71)	(1.64)	(-0.63)	(1.85)	(-0.54)
BHAR	-0.053***	-0.076***	-0.048***	-0.049***	-0.040	-0.106***
	(-4.47)	(-3.83)	(-4.86)	(-4.22)	(-1.46)	(-3.35)
Tobin's Q	0.704***	0.739***	0.326***	0.269***	0.856***	0.857***
	(5.91)	(8.33)	(5.10)	(3.94)	(5.35)	(8.39)
Sales growth	0.081***	0.172***	0.007	0.061***	0.127***	0.178***
	(3.77)	(5.58)	(0.45)	(2.94)	(3.63)	(3.65)
ROA	-0.405***	-0.855***	-0.122**	-0.188***	-0.664***	-1.053***
	(-4.35)	(-9.67)	(-2.36)	(-3.17)	(-4.91)	(-9.75)
Book leverage	-0.107**	-0.033	-0.038	-0.133***	-0.074	0.086
	(-2.50)	(-0.48)	(-0.99)	(-3.73)	(-0.78)	(0.70)
Constant	1.255***	0.351*	1.209***	0.313***	0.645***	1.953***
	(4.25)	(1.94)	(2.98)	(3.03)	(3.38)	(7.17)
Observations	22,066	21,294	14,457	8,385	7,056	11,670
Adjusted R^2	0.330	0.428	0.246	0.251	0.395	0.447

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XVIV: Kaplan-Zingales - Full sample (January 1993-December 2017)

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
			NYS Exchange		*NASDAQ Exchange*	
	High Kaplan-Zingales	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*
CEO_GS67	0.053	0.077*	-0.018	-0.016	0.011	0.122
	(1.03)	(1.69)	(-0.50)	(-0.38)	(0.08)	(1.41)
Log(sale)	-0.291***	-0.208***	0.032	0.016	-0.185**	-0.198***
	(-7.48)	(-6.69)	(1.15)	(0.49)	(-2.38)	(-2.80)
Cash	-0.092***	0.052***	0.004	0.023**	-0.092***	0.041*
	(-4.28)	(3.30)	(0.29)	(2.16)	(-3.04)	(1.73)
Log (PPE/E)	-0.034	0.125***	0.040	0.048	-0.076	0.246***
	(-0.87)	(3.13)	(1.45)	(1.52)	(-0.93)	(2.99)
BHAR	-0.047***	-0.063***	-0.032***	-0.047***	-0.043**	-0.044***
	(-4.85)	(-8.10)	(-5.27)	(-6.32)	(-2.31)	(-3.42)
Tobin's Q	0.679***	0.611***	0.306***	0.318***	0.610***	0.620***
	(14.90)	(11.40)	(7.96)	(6.07)	(10.15)	(7.87)
Sales growth	0.122***	0.146***	0.011	0.018	0.073**	0.163***
	(7.08)	(8.29)	(1.15)	(1.50)	(2.34)	(6.96)
ROA	-0.795***	-0.602***	-0.114***	-0.131***	-0.859***	-0.758***
	(-12.76)	(-10.88)	(-3.34)	(-4.13)	(-11.30)	(-9.96)
Book leverage	-0.066	-0.257***	-0.071***	-0.158***	-0.030	-0.243***
	(-1.53)	(-8.22)	(-2.86)	(-4.82)	(-0.36)	(-4.12)
Constant	0.658**	1.479***	0.798***	1.521***	-0.801	2.717
	(2.05)	(4.98)	(2.73)	(4.62)	(-1.08)	(1.53)
Observations	59,119	59,070	33,236	30,911	20,644	23,365
Adjusted R^2	0.375	0.332	0.218	0.207	0.396	0.367

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XX: Kaplan-Zingales - Dot com bubble (January 1993-March 2000)

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
			NYS Exchange		*NASDAQ Exchange*	
	High Kaplan-Zingales	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*
CEO_GS67	0.327***	0.320***	0.027	0.065	0.814***	0.802***
	(4.92)	(4.40)	(0.53)	(1.14)	(3.78)	(4.29)
Log(sale)	-0.271***	-0.226***	0.048	0.096**	-0.024	-0.387***
	(-5.93)	(-4.69)	(1.06)	(2.41)	(-0.23)	(-3.03)
Cash	-0.060	0.044	0.024	0.039**	-0.054	-0.017
	(-1.35)	(1.26)	(0.57)	(2.07)	(-0.71)	(-0.26)
Log (PPE/E)	0.089	0.232***	0.007	0.064	0.172	0.449**
	(1.48)	(3.58)	(0.16)	(1.26)	(0.98)	(2.24)
BHAR	-0.054**	-0.074***	-0.039**	-0.046***	-0.018	-0.042
	(-2.56)	(-4.30)	(-2.47)	(-2.84)	(-0.48)	(-1.32)
Tobin's Q	0.575***	0.470***	0.306***	0.198***	0.249***	0.266**
	(8.71)	(5.57)	(4.34)	(3.07)	(3.60)	(2.10)
Sales growth	0.094***	0.135***	0.011	-0.016	0.049	0.099**
	(3.95)	(3.46)	(0.73)	(-0.72)	(1.03)	(2.02)
ROA	-0.696***	-0.605***	-0.104	-0.048	-0.559***	-0.629***
	(-6.98)	(-5.77)	(-1.33)	(-1.09)	(-3.48)	(-5.36)
Book leverage	-0.263***	-0.365***	-0.114***	-0.246***	-0.448***	-0.479***
	(-5.64)	(-7.38)	(-2.80)	(-4.24)	(-3.85)	(-3.74)
Constant	0.486	1.669***	0.773**	1.778***	0.452	1.798
	(1.59)	(3.28)	(2.44)	(3.14)	(0.32)	(0.88)
Observations	14,856	14,757	8,810	8,534	3,884	4,076
Adjusted R^2	0.358	0.297	0.189	0.225	0.381	0.334

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XXI: Kaplan-Zingales - Dot com crash (April 2000-September 2002)

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
			NYS Exchange		*NASDAQ Exchange*	
	High Kaplan-Zingales	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*
CEO_GS67	0.137	0.060	0.009	-0.008	0.197	0.029
	(1.20)	(0.68)	(0.14)	(-0.12)	(0.89)	(0.16)
Log(sale)	-0.280***	-0.232***	0.074*	0.117***	0.030	-0.395***
	(-3.79)	(-4.11)	(1.78)	(2.85)	(0.27)	(-3.27)
Cash	-0.094*	-0.002	-0.033	0.040	-0.022	-0.048
	(-1.91)	(-0.06)	(-0.81)	(1.44)	(-0.54)	(-1.08)
Log (PPE/E)	0.078	0.235***	0.084*	0.051	-0.011	0.349**
	(1.16)	(3.47)	(1.77)	(1.03)	(-0.08)	(2.00)
BHAR	-0.066***	-0.046***	-0.053***	-0.050***	-0.030	0.005
	(-3.55)	(-2.68)	(-3.91)	(-2.99)	(-1.04)	(0.19)
Tobin's Q	0.537***	0.439***	0.251***	0.244***	0.278***	0.422***
	(7.88)	(5.75)	(5.26)	(4.06)	(4.22)	(3.07)
Sales growth	0.062	0.061*	-0.037***	-0.042***	0.016	0.010
	(1.31)	(1.95)	(-2.60)	(-2.99)	(0.22)	(0.24)
ROA	-0.670***	-0.456***	-0.033	-0.103**	-0.372***	-0.327***
	(-5.27)	(-6.77)	(-0.65)	(-2.40)	(-3.75)	(-2.68)
Book leverage	0.006	-0.334***	-0.074	-0.254***	-0.110	-0.154
	(0.07)	(-5.75)	(-1.28)	(-3.92)	(-1.03)	(-0.99)
Constant	0.135	0.700***	0.297***	0.897***	0.555*	0.711
	(0.65)	(3.45)	(2.81)	(4.92)	(1.68)	(1.25)
Observations	5,835	5,522	3,313	2,911	1,875	1,911
Adjusted R^2	0.370	0.348	0.308	0.241	0.307	0.317

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XXII: Kaplan-Zingales - Post dot com crash (October 2002-September 2007)

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
			NYS Exchange		*NASDAQ Exchange*	
	High Kaplan-Zingales	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*
CEO_GS67	-0.042	0.010	-0.089	-0.009	0.112	0.083
	(-0.42)	(0.16)	(-0.89)	(-0.14)	(0.84)	(0.74)
Log(sale)	-0.281***	-0.176***	0.042	0.026	-0.127	-0.200**
	(-4.81)	(-4.45)	(1.07)	(0.73)	(-1.14)	(-2.33)
Cash	-0.044	0.073***	-0.028	-0.011	0.046	0.090***
	(-0.95)	(3.22)	(-0.89)	(-0.58)	(0.85)	(3.27)
Log (PPE/E)	0.098*	0.172***	0.095*	0.045	0.024	0.229**
	(1.75)	(3.38)	(1.91)	(1.17)	(0.22)	(2.16)
BHAR	-0.030	-0.026	-0.020*	-0.025	-0.030	-0.038
	(-1.60)	(-1.60)	(-1.69)	(-1.55)	(-0.87)	(-1.33)
Tobin's Q	0.680***	0.641***	0.316***	0.420***	0.534***	0.645***
	(8.60)	(8.61)	(3.88)	(4.86)	(5.05)	(5.62)
Sales growth	0.132***	0.134***	0.009	0.029*	0.062*	0.156***
	(5.34)	(5.48)	(0.66)	(1.67)	(1.90)	(4.13)
ROA	-0.828***	-0.527***	-0.134***	-0.129**	-0.691***	-0.707***
	(-6.96)	(-8.22)	(-3.02)	(-2.47)	(-6.18)	(-7.26)
Book leverage	0.012	-0.284***	-0.068	-0.182***	0.136	-0.243**
	(0.20)	(-5.80)	(-1.42)	(-3.51)	(1.45)	(-2.46)
Constant	0.485	1.669***	0.364	1.607***	0.152	1.754***
	(1.47)	(7.28)	(1.54)	(13.92)	(0.37)	(5.66)
Observations	12,098	12,279	6,624	6,378	4,332	4,985
Adjusted R^2	0.372	0.364	0.243	0.244	0.362	0.399

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XXIII: Kaplan-Zingales - Global financial crisis (October 2007-June 2009)

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
			NYS Exchange		*NASDAQ Exchange*	
	High Kaplan-Zingales	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*
CEO_GS67	-0.228	-0.101	-0.060	-0.165	-0.228	-0.101
	(-0.84)	(-1.04)	(-0.92)	(-1.54)	(-0.84)	(-0.66)
Log(sale)	-0.280**	-0.209***	0.032	-0.036	-0.280**	-0.096
	(-2.23)	(-4.14)	(0.73)	(-0.62)	(-2.23)	(-0.98)
Cash	-0.227***	0.032	0.039	0.122*	-0.227***	0.010
	(-3.15)	(0.71)	(0.86)	(1.76)	(-3.15)	(0.20)
Log (PPE/E)	-0.320**	0.016	0.033	-0.002	-0.320**	0.156
	(-2.15)	(0.20)	(0.86)	(-0.03)	(-2.15)	(1.19)
BHAR	-0.079	-0.048**	-0.012	-0.033*	-0.079	-0.033
	(-1.39)	(-2.15)	(-0.69)	(-1.88)	(-1.39)	(-0.99)
Tobin's Q	0.716***	0.760***	0.280***	0.340***	0.716***	0.780***
	(5.36)	(6.07)	(3.41)	(2.76)	(5.36)	(4.55)
Sales growth	0.181**	0.206***	0.019	0.019	0.181**	0.278***
	(2.17)	(6.44)	(1.07)	(0.75)	(2.17)	(6.14)
ROA	-1.113***	-0.734***	-0.135***	-0.128**	-1.113***	-0.971***
	(-8.15)	(-7.57)	(-2.99)	(-2.20)	(-8.15)	(-7.58)
Book leverage	0.027	-0.283***	-0.043	-0.079	0.027	-0.440***
	(0.15)	(-3.84)	(-1.10)	(-1.07)	(0.15)	(-3.58)
Constant	0.286	0.835***	0.540	0.818**	0.286	1.068***
	(0.79)	(3.17)	(1.08)	(2.28)	(0.79)	(4.60)
Observations	1,945	4,739	2,501	2,234	1,945	2,275
Adjusted R^2	0.491	0.390	0.204	0.188	0.491	0.458

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel XXIV: Kaplan-Zingales - Post global financial crisis (July 2009-December 2017)

	Dependent Variable = R&D/Total Assets (%)					
	Galasso and Simcoe (2011)					
			NYS Exchange		*NASDAQ Exchange*	
	High Kaplan-Zingales	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*	*High Kaplan-Zingales*	*Low Kaplan-Zingales*
CEO_GS67	-0.088	-0.027	-0.033	-0.078	-0.342*	0.002
	(-1.01)	(-0.38)	(-0.67)	(-0.97)	(-1.65)	(0.01)
Log(sale)	-0.262***	-0.213***	0.004	-0.060	-0.176	-0.140*
	(-4.39)	(-5.09)	(0.11)	(-1.13)	(-1.46)	(-1.75)
Cash	-0.105***	0.066***	0.015	0.013	-0.126***	0.083**
	(-3.33)	(2.69)	(1.06)	(0.67)	(-2.79)	(2.38)
Log (PPE/E)	-0.080	0.063	0.031	0.046	-0.082	0.196**
	(-1.45)	(1.19)	(0.90)	(1.20)	(-0.73)	(2.05)
BHAR	-0.057***	-0.093***	-0.038***	-0.068***	-0.085**	-0.078***
	(-2.81)	(-6.69)	(-3.61)	(-5.21)	(-2.11)	(-3.59)
Tobin's Q	0.828***	0.732***	0.327***	0.403***	0.887***	0.785***
	(10.07)	(8.63)	(5.94)	(4.61)	(9.23)	(7.08)
Sales growth	0.121***	0.177***	0.024	0.056***	0.104	0.219***
	(3.61)	(7.30)	(1.32)	(2.98)	(1.62)	(6.14)
ROA	-0.875***	-0.699***	-0.146***	-0.236***	-1.105***	-0.911***
	(-9.12)	(-7.55)	(-2.97)	(-3.56)	(-9.83)	(-7.43)
Book leverage	-0.033	-0.177***	-0.067*	-0.121***	0.055	-0.155*
	(-0.50)	(-4.09)	(-1.76)	(-3.01)	(0.44)	(-1.89)
Constant	1.337**	1.004**	0.952**	0.931**	0.751***	-0.218
	(2.03)	(2.37)	(2.06)	(2.11)	(3.18)	(-1.01)
Observations	21,587	21,773	11,988	10,854	8,608	10,118
Adjusted R^2	0.416	0.371	0.259	0.210	0.455	0.410

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Paper 2

Corporate Governance Structure for Overconfident CEOs: A look into Directors Composition, Blockholders and Change of Auditors

Abstract: The structural composition of corporate governance for firms with overconfident CEOs is investigated in this study. In line with our previous research, we are particularly interested in corporate governance mechanisms for firms led by overconfident CEOs. We continue the discussion by splitting our research question into internal and external corporate governance mechanisms. We look at board size, board independence, board age demographics, and the presence of co-opted directors on the board to explore the internal configuration of corporate governance. For external corporate governance, we focus on the presence of Blockholders and the market size (big 4 and big 5) of the firm's auditor. We conclude that the boards of Overconfident CEOs are smaller, less independent (the CEO has greater influence through CEO Duality) and have directors who are younger. To further assist greater CEOs power, we also observe more likelihood of co-option for such firms compared to non-overconfident CEOs. For external governance mechanism, we observe reduced shareholding percentage and number of Blockholders, both affiliated and outsiders. Having fewer blockholders gives CEOs the opportunity to execute their preferred corporate strategic decisions. These companies are also less likely to use Big 4 or Big 5 audit firms as their financial auditors, and thus have more capacity to interfere with audit process. All the components of internal and external governance indicate that overconfident CEOs prefer to have less noise and more control over the board to implement their version of optimum policy.

JEL classification codes: G32, G34, K22

Keywords: overconfident CEOs; corporate governance; co-opted directors; bockholders

1. Introduction

The structure and efficacy of corporate governance systems have been widely studied in previous research; much of which emphasize the importance of Board of Directors as a vehicle for improving firm performance. Diversity in board structure has received considerable attention, however there is a need to comprehend the meanings of within discrepancies more thoroughly (Lawrence, 1997). Harrison and Klein's (2007) diversity typology uses separation, variety and disparity to explain institutional variation model. We incorporate their theory to empirically test diversity in board formation; and particularly look into firms headed by overconfident and non-overconfident CEOs. The three diversity categories differ from one another fundamentally. Separation refers to variations in a unit's members' positions along a horizontal continuity. Variety reflects access to multiple sources of knowledge and describes variances among unit members from various categories. Disparity refers to variances in how each unit member uses a valuable resource. The distribution of where members stand on a value, belief, attitude, or orientation is reflected in separation, which is a reflection of stand point or position. Variety reflects information: the distribution of each unit member's knowledge that sets them apart from other members as a result of the distinctive material of their training, experience, or education. The distribution of how much of a socially valued good each unit member has is what disparity displays in possession. We test this typology in context of board formation by looking into board size, independence, age demographic, co-option, blockholders and auditors' nature; and explain how these factors influence firm corporate governance.

Improved company performance, organization's reputation and legitimacy, are all connected to good corporate governance (Bear et al., 2010; Grove et al., 2011). Elements of corporate governance have changed through times and recent studies could challenge some of the governance literature's prevalent assumptions about how players and organizations work (Mcnulty et al., 2013; Parker, 2017). Formal procedures like board assessment and assurance can assist build trust in a board's capacity and independence. According to agency theory, a capable and independent board that is subject to review and assurance should limit management's ability to take rent (Jensen and Meckling, 1976).

Firm-specific governance differences are also likely to influence information transparency of the firm (Christensen, 2016). However, the various management control mechanisms utilized for a notion as broad as corporate governance are challenging to separate for causal research because many are likely to be interconnected (Endrikat et al., 2020). There have been increasing calls for a new approach to corporate governance than the shareholder-first strategy that currently dominates the literature (Cheung, 2018; Endrikat et al., 2020; Grove et al., 2011). The dominance of quantitative research methods over qualitative or mixed methodologies has resulted in corporate governance procedures being overlooked in academic research and hence corporate governance understanding is being compromised (Parker, 2017). Looking at corporate governance through the lens of behavioural science, specially of top managers (the CEO) and board members, gives new perspective as they exert significant influence over corporate governance procedures and organizational culture (Hambrick et al., 2008). In addition to monitoring managers, boards can grant access to networks and resources, meaning that resource dependence theory is a relevant viewpoint to investigate (Endrikat et al., 2020; Hillman and Dalziel, 2003). Short et al. (2010) find that board and management views toward corporate governance capture narrative disclosures rather than quantitative disclosures in annual reports, implying that content analysis could be a good tool to apply. The Enron scandal and 2007-08 financial crisis have emphasized substantial governance shortcomings to achieve its obligations. One of the most important concerns under evaluation by corporate governance efforts is the board of directors. Because of the wide dispersion of common stock ownership, the board of directors are in charge to carry out the monitoring function on behalf of shareholders. The effectiveness of board highly depends on the treaty brought on from top management or CEOs.

According to the leadership theory, CEOs are vital to a company's success because, as organizational leaders, they make key decisions about the company's strategy, general mission, and culture (Khurana, R., 2011). CEOs make management decisions and set the strategic direction of the company (Langevoort, D.C., 2004). CEOs are often charming people with strong personalities who are capable of leading and influencing others. Furthermore, when faced with changes in board structure that strengthen the board's

independence, CEOs show more ingratiation and persuasion toward board members to cushion their power loss (Westphal, 1998). Research consistently shows that CEOs actively seek to earn and maintain power to mitigate the loss of authority. We contribute to this segment of literature by incorporating the qualitative aspects, such as the behavioural bias of top management (CEOs) and investigate the board formation for firms lead by them. The psychological attributes of overconfident CEOs may prevent the board from challenging CEOs' ideas, strategies and plans (Barnard, 2008). Langevoort (2004) conclude that CEOs have power over the board and management by sheer personality from overconfidence. Overconfidence creates an environment in which the CEO is treated with disproportionate respect by management and the board of directors. Several literatures also verifies that dominant persons who have superior task and social competence gain influence because they appear competent to others, even if they do not have it. They assume command through nonverbal cues. These people don't just take command by force; they also exert authority by their charismatic personalities (Langevoort, 2004). CEOs are responsible to pass information to the board of directors and investors, and they have significant influence over investment decisions (Adams and Ferreira, 2007; Song and Thakor, 2006). The relationship between CEO information-provision incentives and corporate governance effectiveness is well recognised, as evidenced by the Sarbanes-Oxley Act (Sarbox) and existing corporate governance research (Adams and Ferreira, 2007; Almazan and Suarez, 2003; Harris and Raviv, 2008; Hermalin and Weisbach, 1998, 2003; Lorsch and MacIver, 1989; Shleifer and Vishny, 1997; Song and Thakor, 2006).

We fill the gap in governance literature incorporating CEO overconfidence as an indicator to analyse firm governance. Overconfident CEOs have had a varied effect on the company. A vast stream of literature documents how firm headed by overconfident CEOs handle their business process. Researchers studied CEO overconfidence interaction with corporate decisions such as dividend policy (Deshmukh et al., 2013), investments strategies (Hackbarth, 2009), mergers and acquisitions (Malmendier and Tate, 2008), financial risk (Malmendier and Nagel, 2011), and corporate governance (Kim and Lu, 2011; Van den Steen, 2004). Malmendier and Tate (2008) finds CEO overconfidence to clarify the high merger and acquisition (M&A) decisions for firms, while Billett and Qian (2008)

documents its association with elevated M&A frequencies. In our earlier research, we documented the impact of board domination on overconfident CEOs R&D decision; and considering the empirical evidence, it is worthwhile to look into the mechanism of governance formation for firms lead by overconfident CEOs. Corporate governance is associated with firm culture (Llopis et al., 2007), which is in turn interlinked with management attitudes. Academics have proposed that a behavioural science approach to corporate governance might be beneficial, particularly because top managers (the CEO) and board members have significant influence on corporate governance procedures and organizational culture (Hambrick et al., 2008). Corporate governance practices are likely to be determined by the tone at the top of an organization. For instance, unethical leadership was documented as the main reason for numerous corporate governance scandals (Boddy, 2013). Senior executives in firms with charismatic leaders frequently agrees with CEO's ideas than confronting to problems (Haleblian and Finkelstein., 1993). Following the Enron scandal, for example, investigations indicated that management either supported the CEO in cultivating a culture of dishonesty or feared retaliation if they disagreed. Only few executives intervened to stop Enron's flashy leaders from pursuing their ill-conceived initiatives (Dallas, L.L., 2017). Higher CEO pay and a higher utilization of compensation consultants are linked to companies with perceived weaker governance (Armstrong et al. 2012).

In this paper we look into this by taking CEO overconfidence as primary indicator and evaluating the board formation of firms headed by overconfident CEOs. The literature contribution of this study is the structural formation of corporate governance for firms with overconfident CEOs and provide empirical explanation to these CEOs non-conventional style of corporate policies. We take the discussion forward and segment research questions into internal and external aspects of corporate governance. In line with our prior research, we focus on the corporate governance mechanism for firms headed overconfident CEOs. For internal facets of corporate governance, we investigate Board Size, Board Independence, Board Age demography and Presence of Co-opted Directors in the Board. For external corporate governance, we examine the shareholding percentage and number of Blockholders on Board and market size (Big 4 or Big 5) of Auditor in the firm.

2. Literature Review

There are two major legal approaches to governance regulations; a highly prescriptive 'apply or die' approach, such as the Sarbanes–Oxley Act (SOX) 2002, which imposes substantial financial and criminal penalties for noncompliance; or a more self-regulatory principles-based 'apply or explain' approach, such as the Cadbury Code of 1992, which was later developed into the UK Combined Code (Calder, 2008). The 'apply and explain' (apply principles and explain practice) method, which is a trademark of the King IV governance code in South Africa, supports an outcomes-based view of governance established on Integrated Reporting, is a further refinement of the principles-based approach (IODSA, 2016). Following a spate of major corporate governance crises, most notably the Enron case, SOX is arguably the most significant piece of corporate governance legislation ever implemented. SOX establishes a set of rules that have led to stock exchanges tightening their requirements for director independence and the formation of committees led by non-executive directors (Bebchuk et al., 2009). SOX's obligatory disclosures relating to internal controls are intended at minimizing information asymmetry, particularly due to excessive executive discretion, as seen in the Enron case. Corporate scandals have reignited interest in corporate governance disclosures across the board of all industries (Calder, 2008). Scandals in a specific industry may result in greater regulatory and public attention for all companies in that industry, regardless of their individual corporate governance track record (Bebchuk et al., 2009).

Much of the study on corporate governance reporting focuses on whether effective corporate governance proceeds positive financial performance (Grove et al., 2011). Tobin's Q, improved cost of capital and upgrades in corporate governance ranking index are such typical indicators. Many studies look at the causal links between external variables like country-specific legislative advice and internal ones like company-specific controls to report corporate governance information (Cahan et al., 2016). Non-financial disclosures can indicate underlying changes in corporate governance procedures and internal control quality (Wang, 2010). Corporate governance studies have often been criticised for using and measuring multiple country-level factors to explain country and firm-specific

governance mechanisms, making comparisons difficult (Schiehll and Martins, 2016), and as well focusing on an economic rather than an institutional perspective. Our study overcomes this limitation as we use firm and executive level controls to study governance mechanism of the publicly traded firms in the United States. This allows us to investigate individual dynamic forces of corporate governance rather than constitutional governance codes. We explore board of directors' composition to explain the non-conventional behaviour of overconfident CEOs by looking into internal and external elements of corporate governance. Social identity and group leadership research argue that CEOs have power over a group as the group's leaders (board or management). Members of the organization follow with the CEO's wishes because they trust him to act in the best interests of the group, no matter how unusual their actions are. Cohesive groups identify with a strong leader and are more likely to follow the leader's instructions. Because boards are so close and homogeneous, they often rely on social standards, which limits their ability to notice the CEOs irrational judgement. The Dot Com Crash have empowered the directors to question CEOs decision, although social norms still remain in which "being forceful" in the boardroom might be regarded as undermining the board as a group or club (Barnard, 1998).

The CEO regulates the firm corporate governance process in numerous ways. They have an influence in who is nominated to serve on the board as directors (Kahan, 2000). Directors appointed to a board by the CEO (co-opted Directors) are commonly beholden to them. CEOs often choose directors who share the same social and economic value, and also those who are most likely to strengthen their position as CEOs. As a result, this assembled board has limited candid discussions because a director nominated by the CEO is unlikely to question the CEO's decision-making actively. CEOs also have control over the information flow to the board of directors (Barclift, 2009). Thus, much of corporate governance process is managed by the CEO, who selects the information the board reviews and approves at board meetings (Coffee, 1986). This results in an information blockade which usually result in the board making a less-than-informed decision.

2.1. Board Size

Board size is a typical proposition for improving board effectiveness. In a working document titled "Corporate Governance in Financial Institutions: Lessons to be Drawn from the Current Financial Crisis, Best Practices," the European Commission argues that diversity broadens boardroom debate and helps to avoid the danger of narrow "group thinking". Large boards are viewed as a diversified group that is typically receptive to stakeholders' concerns and they are found to be engaged more social and ecological practices (Endrikat et al., 2020, Frias-Aceituno et al., 2013; Ntim and Soobaroyen, 2013). Lack of diverse views within boards may, in some cases, have contributed to the failure board members to effectively challenge management decisions (COM, 2010:8). Academic studies support the idea that the size of a board (number of board members) might improve management skill and knowledge, which should increase the quality of information disclosure (Cooray and Senaratne, 2020; Jizi et al., 2014). Not only does large board size offer a range of expertise, but it also implies that organizations might possibly profit from board members' contacts (Endrikat et al., 2020).

On the contrary, large boards, according to Lipton and Lorsch (1992) and Jensen (1993), are less effective due to agency issues. Any committee with a large number of decision-makers may lessen their effort and allow for some free-riding. Using a sample of US firms, Yermack (1996) tests these arguments empirically and finds that having a small Board of Directors improves company performance and positively effects investor behavior and company value. The findings also show that investors prefer a smaller Board of Directors and react negatively to Board size. These results are further supported by Benson et al., (2011) and Cannella et al., (2008). The size of the Board of Directors can also have an impact on the Chief Executive Officer (CEO) compensation incentives, as compensation programs are a major responsibility of the Board of Directors. According to Yermack (1996), CEO salary is higher in companies with smaller boards of directors. Additionally having more directors on board could result in extra scrutiny over the CEO. We therefore hypothesize that overconfident CEOs will have less directors on board to lower the level of monitoring.

Hypothesis 1a: Overconfident CEOs have smaller board size

2.2. Board Independence

Board independence is also associated with improved corporate disclosure quality (Xia and De Beelde, 2018) and financial performance (Chou et al., 2013). From a resource-dependency perspective, the independence of board members suggests more external contacts and connections which could benefit the firm (Hillman and Dalziel, 2003). Rosenstein and Wyatt (1990) discover "a positive stock price effect" when an outsider is appointed to a company's board of directors. Having more non-executive directors (NEDs) can limit CEOs dominance over decision-making (Forker, 1992). The number of nonexecutive directors (NEDs) on a board increases the frequency of board and committee meetings, suggesting that having independent directors may contribute to enhance corporate governance policies (Greco, 2011). However, this formal measure may miss the informal network connections between directors and the CEO outside the boardroom which could compromise director independence (Fracassi and Tate, 2012).

The absence of CEO duality (the CEO and board chair roles being held by the same individual) is another widely used measure of board independence. Agency theory assumes that the absence of CEO Duality would mean executives not being able to dominate decision-making, which should improve the information flow to stakeholders (De Villiers et al., 2011; Forker, 1992). Shareholders view an external board chair as a favourable element that improves the board's independence and authority (Lorsch and MacIver, 1989). However, research supporting these basic assumptions of agency theory are inconclusive (Grove et al., 2011), involving multiple differing measures of both board independence and financial performance (Dalton and Dalton, 2011).

In this paper, we measure board independence by the CEO duality indicator, as prior research suggests that directors' ability to monitor management is reduced when the CEO-Chairman influences board meeting agendas (Jensen, 1993; Bebchuk et al., 2002;

Bebchuk and Fried, 2003; Davila and Penalva, 2006) and financial reporting quality becomes substandard too (Dechow et al., 1996; Imhoff, 2003; Farber, 2005).

Hypothesis 1b: Overconfident CEOs have lower board independence, i.e., overconfident CEOs have higher CEO duality (CEOs are assigned as chairperson/president of the Board)

2.3. Age Demographic of Board of Directors

Young directors are often portrayed as reckless and overconfident, whereas senior members are seen as careful and wise (Reyna, 2012). In comparison to elder managers, younger managers make more bolder, and riskier investments. Prendergast and Stole (1996) propose a management signalling model in which younger managers use riskier and more aggressive investment methods to let the market assume that they are proficient high-quality managers. Younger managers, often misrepresent their own ideas and investment behavior in order to appear talented. On the other hand, elder managers are hesitant to modify their investing strategy because it could create doubts about their past selections.

Tränkle, Gelau, and Metker (1990) theorized that young directors are simply more risk tolerant. Furthermore, the popular perception of young people as overconfident focuses on their overestimation of own chances of success and invulnerability. Hambrick and Mason (1984) suggest three reasons why younger managers are often associated with attempting the unique, unprecedented and taking risks when considering the influence of managerial backgrounds in organizational outcomes. Firstly, senior executives may have reached a stage in their lives where financial and job security are more crucial. Second, elder executives may be more committed to the company's current state. Finally, senior managements may lack mental and physical stamina, as well as the ability to acquire new concepts and learn new habits. Furthermore, senior managers have a tendency to seek out more information, assess information more thoroughly, and make judgments more slowly (Taylor, 1975). Wiersema and Bantel (1992) focus on the Board of Directors' age

demographic features and their impact on the firm's strategic decisions. They report a negative relationship between the average age of Board members and changes in corporate strategies, based on a sample of 100 firms in 1983. This shows that, in comparison to older directors, younger directors are more tolerant of taking risk and are more likely to accept major corporate policy changes. According to Bernardo and Welch (2001), Goel and Thakor (2000), Schelling (1960) and Van den Steen (2005) overconfident CEOs prefer being surrounded by like-minded individuals, and therefore, we hypothesize that overconfident CEOs will have more younger directors on the board compared to their counterparts.

Hypothesis 1c: Overconfident CEOs have more younger Directors on Board

2.4. Presence of Co-opted Directors

Two strands of research use a socially embedded approach to link the CEO's preferences to board structure. According to the first line, CEOs may utilize their power to pick directors who are less likely to criticize the policies recommended by the CEO. According to studies in this stream (Westphal & Zajac, 1995, 1997), CEOs prefer less diverse boards to avoid extra monitoring. According to the second stream of research, CEOs favor directors who are similar to themselves. This reasoning supports the similarity-attraction paradigm, which states that people are drawn to and work better with others who are similar to them (Byrne, 1971). For example, Westphal and Zajac (1995, 1997) investigated the director recruiting process and found that CEOs routinely select directors who share comparable demographic traits. Such preference for similarity might be stronger for minority CEOs, and they might nominate other minorities on the board, given their rarity and difficulty progressing to the higher echelons of organizations (O'Higgins, 2002; Zelechowski & Bilimoria, 2004), As a result, similar-to-me biases is observed between the CEO and board of directors.

Co-opted board members are appointed after the CEO started in office. Coles, Daniel and Naveen (2014) find that more that co-option increases CEO tenure, CEO pay; and weakens CEO turnover-performance sensitivity. Despite the Sarbanes-Oxley Act of 2002 (SOX), the NYSE and NASDAQ established listing criteria that limits the CEO's immediate influence in the nomination process; Carl Icahn, an activist investor, says explicitly in Business Week Online on November 18, 2005, that *"members of the boards are cronies appointed by the very CEOs they're supposed to be watching."* CEOs are highly likely to have significant power on the selection of co-opted board members. At the very least, they approve the list of directors, which is nearly invariably approved by shareholders (Hermalin and Weisbach 1998; Cai, Garner, and Walkling, 2009). Finkelstein and Hambrick (1989) find CEOs to co-opt the board by choosing "sympathetic" new directors. According to Hwang and Kim (2009), CEOs prefer appointees who hold similar beliefs. Co-opted directors are thus an essential factor to examine the mechanism of board, more specifically for overconfident CEOs.

Hypothesis 1d: Overconfident CEOs have higher Co-option

2.5. Percentage Shareholding and Number of Blockholders

Institutional or block shareholders who may affect corporate performance (Bushee, 1998) and disclosures (Bae et al., 2012) are a crucial component of external governance. Holderness (2009) finds 96% of US firms contain at least one blockholder; this ratio is the 15th highest out of 22 countries that he studies. Edmans and Manso use data from Dlugosz, Fahlenbrach, Gompers, and Metrick (2006) and find 70% of US firms have multiple blockholders. Using a 10% threshold, Laeven and Levin (2007) find this number to be 34% for European firms, Maury and Pajuste (2005) document 48% for Finland, and Western European data made available by Faccio and Lang (2002) gives a figure of 39%. Blockholders are widespread across firms, and thus their influence on corporate governance ought to have major impact. Perhaps the simplest piece of evidence in favour of blockholders effecting governance is their sheer presence. Holderness (2009) finds that

most firms around the world have either inside or outside blockholders. From a Darwinist viewpoint, if blockholders did not improve firm value, then distributed ownership would have been much more common. Although it is tricky to assign causality of correlation between blockholdings and explicit firm outcomes, Holderness and Sheehan (1988) find that, compared to dispersed ownership firms, firms with more blockholders show significant differences in investment, accounting returns, Tobin's Q, leverage, and the frequency of corporate control transactions. The voice theory of Burkart, Gromb, and Panunzi (1997) and the exit theory of Edmans (2009) predicts concave relationship between block size and firm value. Barclay and Holderness (1991) find that swaps of large blocks between investors (insiders or outsiders) lead to a 16% increase in market value. Gorton, Huang, and Kang (2013) obtain a positive connection between the number of blockholders and price informativeness. Dechow, Sloan, and Sweeney (1996) and Farber (2005) find that earnings manipulation is lower when firms have more outside blockholdings.

The presence of blockholders and the size of their holdings is a shared explanatory variable in financial research. Such representative studies include analyses of the role of blockholders in executive turnover, executive compensation, firm diversification, discretionary expenses, market liquidity, and corporate performance. Research find intervention from outside blockholders has more significant effects. Insiders maybe influenced, to some extent, by board of directors or CEOs. Outside blockholders are not the firm's officers and regarded as independent shareholders. Holderness and Sheehan (1985) demonstrate that the market responds more optimistically to block acquisitions by outsiders as compared to insiders. Chen, Harford, and Li (2007) find that independent blockholders monitoring results in improved M&A performance and the retraction of poor M&A bids, especially if stakes are high. Baysinger, Kosnik, and Turk (1991) find more R&D for higher institutional blockholders, and Lee (2005) shows a positive correlation between aggregate blockholder ownership and patents. Atanassov (2013) shows that the presence of an outside blockholder lowers the adverse impact of anti-buyout legislation on patent citations. Aghion, van Reenen, and Zingales (2013) find citation-weighted patents to be positively related with institutional ownership. Evidence on international markets also

show the dominance of outside blockholders. Lins (2003) studies 18 emergent markets and finds positive association of Tobin's Q with percentage ownership outside non-affiliated blockholders. This correlation is especially prominent in countries with low investor protection law. Claessens, Djankov, Fan and Lang (2002) explore 8 East Asian economies and conclude that the market-to-book ratio increases with non-associated blockholders shareholdings. In contrast, when the largest blockholder is affiliated with the firm, valuations move negatively to its ownership holding. Bradley, Brav, Goldstein, and Jiang (2010) show that outside blockholders successfully eliminate closed-end funds discounts and convert them to open-end. Activism shots became mostly frequent after the 1992 proxy form that cut the costs of communication among shareholders and increase intervention. Using 13F filings, Burns, Kedia and Lipson (2010) study institutional ownership concentration, measured by the Herfindahl index, and find fewer restatements for higher concentration. In the wake of this debate, we examined both inside and outside blockholders to obtain complete results rather than just corresponding effects of the management decisions.

Blockholders are diverse class containing groups of investors like hedge funds, mutual funds, pension funds, individuals, and corporations. The literature of blockholders on corporate governance is a rich and varied. The research on inside blockholders are covered by reviews of the CEO compensation literature, such as in Murphy (1999, 2013), Edmans and Gabaix (2009), and Frydman and Jenter (2010). However, their structural mechanism for firms headed by overconfident CEOs is an untapped area. Literature suggests that blockholders increase corporate scrutiny and hence we predict that CEOs might not prefer having them around. Based on the discussions, we hypothesise that firms headed by overconfident CEOs will have lower concentration of blockholders. To analyse this aspect, we use percentage shareholding and number of all, outside and officer blockholders. Using three groups gives us the access to both dependent and independent blockholders.

Hypothesis 2a: Overconfident CEOs have smaller percentage of Blockholders shareholdings and fewer number of blockholders.

2.6. Nature of Auditor

Managerial overconfidence raises the likelihood of corporate misrepresentations due to optimistic bias in accounting judgment (Schrand and Zechman, 2012) and undermining accounting conservatism (Ahmed and Duellman, 2013); implying that overconfident managers use more aggressive reporting tactics. Presley and Abbott (2013) linked overconfidence CEOs to a greater risk of financial restatements. Hsieh et al. (2014) show that managerial overconfidence undermines regulators' efforts to improve financial reporting practice in the post-Sarbanes (SOX) period. Additionally, they argue that overconfident CEOs feel less constrained in their post-SOX earnings management decisions and continue to exploit opportunities for certain types of earnings management.

Audit committees are actively involved in enhancing company disclosures by focusing on internal controls and high-quality reporting systems. An audit committee's relative independence (achieved by having a larger number of independent members) should also enhance disclosure quality (Forker, 1992). A separated risk management committee is viewed as a crucial component in research, notably for the provision of high-quality risk-related information disclosures (Tao and Hutchinson, 2013). Duellman et al. (2015) find evidence of a negative relationship between managerial overconfidence and audit fees in companies that lack strong audit committee supervision, which is consistent with the demand-side perspective that overconfident managers seek less auditor scrutiny and thus prefers lower-quality audit services. A strong audit committee mitigates the managers propensity to interfere with the audit process and demand more audit services. Larger accounting firms, according to Dopuch and Simunic (1980), provide higher-quality services because they have more reputations to preserve. Furthermore, it may be argued that Big 4 firms provide higher-quality audits due to their size, which allows them to implement more thorough training programs, standardized audit techniques, and more possibilities for acceptable second partner evaluations. Numerous empirical studies (Palm rose, 1988; Becker et al., 1998; Khurana and Raman, 2004; Behn et al., 2008) find evidence suggesting that Big 4 auditors provide higher-quality audits than non-Big 4 auditors. Contributing to this literature, we argue that having one of the Big 4 accounting firms

(Deloitte, Ernst & Young, KPMG and PwC) as their financial auditor is less like for such firms. To investigate this, we look into changes in auditor from Big 4 after the CEO took charge.

Hypothesis 2b: The likelihood of changing Big 4 to non-Big 4 firms as financial auditor is higher for firms with Overconfident CEOs.

As a robustness check, we further consider the change of Big 5 accounting firms (Deloitte, Ernst & Young, KPMG, PwC and Arthur Andersen) to non-Big 5 firms as financial auditors for overconfident CEOs.

3. Research Methodology

3.1. Data and Sample

Our analysis is based on CEOs and boards of directors of US listed firms from 1996-2001. We collect managerial compensation data from Standard and Poor's Execucomp, firm financial and accounting variables from Compustat and stock returns from the Center for Research in Security Prices (CRSP) database. Following previous studies (Galasso and Simcoe, 2011; Hirshleifer et al., 2012) we exclude financial and utilities industry, missing information on variable used to calculate CEO overconfidence measure and all control variables needed for the base specifications. All financial and accounting variables are winsorised at 1% and 99% to eliminate the effects of outliers. We analyse internal and external components of corporate governance for firms headed by overconfident CEOs.

We use separate models to analyze each component of corporate governance. For internal corporate governance, we look into Board Size, Board Independence, Board Age Demographic and Presence of Co-opted Directors. For the former three, we use Compustat

data source and for co-option we use data from "*Coles, J.L., Daniel, N.D., and Naveen, L., 2014. Co-opted Boards. The Review of Financial Studies 27, 1751-1796"*.

For external mechanism analysis of corporate governance, we use Blockholders data from BoardEx and Auditors data from WRDS Audit Analytics.

3.2. Model Strategy

To assess the internal and external components of board structure, we use the following model:

$$y_{i,t} = \alpha_1 + \alpha_2 OC_{i,t-1} + \gamma' Z_{i,t-1} + \beta' X_{i,t-1} + \nu_i + \mu_t + \varepsilon_{i,t} \ldots\ldots\ldots\ldots \text{(i)}$$

where $y_{i,t}$ is firm *i*'s total number of board directors with voting rights in year *t* (for assessing board size), or $y_{i,t}$ is firm *i*'s CEO Duality which measures whether the CEO is also the Chairperson/President of the board in year *t* (for investigating board independence), or $y_{i,t}$ is firm *i*'s average age of all board directors with voting rights in year *t* (for quantifying age demographic of the board), or $y_{i,t}$ takes the value 1 if firm *i* has appointed co-opted directors in year *t* and 0 otherwise (for identifying the presence of Co-opted directors on the board), or $y_{i,t}$ is the percentage of shares owned by all (1), outside (2) or officers (3) Blockholders of firm *i* in year *t*, or $y_{i,t}$ is the total number of all (1), outside (2) or officers (3) Blockholders of firm *i* in year *t* (for measuring blockholders influence), or $y_{i,t}$ takes the value 1 if firm *i* had change of auditor from Big 4 to non-Big 4 accounting firms after the CEO took office and 0 otherwise (to assess nature of auditors).

On the right side of the equation, $OC_{i,t-1}$ is a dummy variable that takes a value of 1 if firm *i* has an overconfident executives in year *t-1* and 0 otherwise, $X_{i,t-1}$ is a vector of characteristics of firm *i* in year *t-1*, $Z_{i,t-1}$ is a vector of characteristics of the CEO of firm *i* in year *t-1*, ν_i and μ_t are year and industry fixed effects, respectively, and $\varepsilon_{i,t}$ is the random error.

3.2. Construction of Dependent Variables

3.2.1. Internal Governance

i. Board Size: We measure board size by the total number of board of directors with voting rights in that firm-year. We expect more board size will lead to more diverse opinion and as a result more noise in the firm governance. Therefore, we hypothesise that Overconfident CEOs will have lower number of directors on their board. Here we control for CEO dominance and other firm level variables that might impact the size of the board.

ii. Board Independence (Absence of CEO Duality): We use CEO duality to indicate the extent of board independence. CEO duality takes the value 1 if the CEO and board chair are the same person and 0 otherwise. Holding dual position on the firm gives the CEO more authority. In this case, it is very likely that they will force their decision on the board which could deviate the firm from optimal policy. CEO duality together with overconfident CEO could make the situation more exposed, as overconfident CEOs are known for their risky and bold investment strategy. In line with the psychological characteristic, we hypothesise that the presence of CEO Duality will be more for firms headed by overconfident CEOs.

iii. Board of Director Age Demographic: We take the mean age of all serving directors in that firm-year to account for age demographic of the firm. This helps to assess the age diversity across the board and whether the board consists of more younger or older directors. Previous academic works suggest that younger directors are more likely to take risk and are confident and agile. Goel and Thakor (2000) and Van den Steen (2005) concluded that overconfident CEOs prefer to work with like-minded people. Following this discussion, we hypothesize that overconfident CEOs will have more younger directors on the board to match their investment behaviour.

iv. Presence of Co-opted Directors: We characterize the presence of Co-option as a dummy variable which takes the value 1 if there are co-opted directors in that firm-year and 0 otherwise. Co-opted directors are appointed after the CEO assumes office. Because

the CEO was engaged in their initial appointment, such co-opted directors are more likely to assign their allegiance to the CEO, regardless of whether they are independent or not. A CEO has strong influence over co-opted directors and hence these directors grant more discretion to the CEO. Co-option can also be interpreted as capturing the board's inefficiency in overseeing the CEO. Co-option can be described as the director's reluctance to oversight and lack of independence at the board level. Co-option reflects what the CEO can get away with.

v. Percentage Shareholding and Number of Blockholders: We use data on blockholders in the United States from BoardEx WRDS. We use total percentage of shareholdings and total number of overall, outside (independent) and officer (dependent) blockholders to understand the scope and intensity of their involvement. Outside blockholders (whose voting power is unaffected by company members) are considered as independent blockholders and their presence on the board has shown more significant effect. Gorton et al. (2013), Dechow et al. (1996) and Farber (2005) find that firms with more outside blockholders have superior governance policies. On the contrary, when blockholder are affiliated with the firm, stock prices are inversely associated with its ownership holding.

vi. Nature of Auditor: We use a dummy variable that takes the value 1 if the firm had change of auditor from Big 4 to non-Big 4 accounting firms after the CEO took office and 0 otherwise. Duellman et al. (2015) argue that overconfident managers use aggressive accounting estimations in creating financial details and bargain with their auditors to minimize audit scope. They may prefer lesser-quality audits and cheaper audit costs to avoid high-level auditors scrutinizing their accounting policy decisions. Literature has frequently concluded that Big 4 auditors provide higher-quality audits than non-Big 4 firms (Dopuch and Simunic, 1980; Palm rose, 1988; Becker et al., 1998; Khurana and Raman, 2004; Behn et al., 2008). Therefore, we hypothesize that overconfident CEOs are more likely to change their auditors from Big 4 to non-Big 4 firms to avoid extreme accounting scrutiny. We also investigate the change of auditor from Big 5 to non-Big 5 audit firms for overconfident CEOs.

3.3.2. Construction of Independent Variable: CEO Overconfidence

The study's main independent variable is CEO overconfidence. If a CEO exhibits overconfidence at least twice during his tenure, the individual is regarded overconfident for the rest of his tenure (Glasso and Simmcoe, 2011) or from the first time they exhibit overconfidence (Malmendier and Tate, 2005a, 2008). When a CEO does not exercise an in-the-money option after the vesting period, it suggests s/he believes the stock price will grow more in the future, and they want to capitalize the profit. We use Campbell et al. (2011) to calculate the average moneyness of the executive's option portfolio because precise data on stock option holdings and exercise prices is not available. The average realizable value per option is derived for each CEO-year by dividing the total realizable value of the options by the number of options he holds. The strike price is calculated as the fiscal year-end stock price minus the average realizable value. The average moneyness of the options is then calculated by dividing average realisable value by strike price. Hirshleifer et al. (2012) also computed CEO overconfidence using this method. We only include the unexercised exercisable options held by the CEO.

$$\boldsymbol{Average\ realizable\ value\ per\ option} = \frac{\boldsymbol{Total\ realizable\ value\ of\ the\ options}}{\boldsymbol{Number\ of\ options\ held}}$$

$$\boldsymbol{Strike\ price} = \boldsymbol{Stock\ price} - \boldsymbol{Average\ realizable\ value}$$

$$\boldsymbol{Average\ moneyness} = \frac{\boldsymbol{Average\ realisable\ value}}{\boldsymbol{Strike\ price}}$$

3.3.3. Construction of Control Variables

To examine the structure of corporate governance for overconfident CEOs, we control for several firm and CEO specific characteristics. First, firm size is determined using natural logarithm of total sales of the firm. Second, cash is the free cash flow of the firm scaled by total assets, to account for varying firm sizes. Third, Stock returns is calculated using the Buy-and-hold return over the fiscal year. Fourth, Tobin's Q is the ratio

of firms' market value of the asset to its book value, and it tells how investors perceives the firm. A Tobin's Q more than 1 would imply that market overvalues the firm, and the firm is likely to have good prospects. Fifth, Sales Growth is calculated by dividing the current year sales by the prior year's sales and subtracting 1. This is the primary predictor of profitability and the level of investment a corporation should undertake, as it signals changes in demand for the firm's products and services. Sixth, ROA is the ratio of operating income before depreciation to total assets. Return on asset indicates the profitability of the company relative to its asset. All variables definition is listed in the Appendix II (B).

4. Results

4.1. Descriptive Statistics

4.1.1. Internal Governance

The summary statistics for all variables utilized in this study are listed in Table 1 and Appendix II (D), Table 6. Table 1 list the statistics for the dependent variables, while a detailed sample specific statistics are outlined in Appendix II (D) Table 6. Table 6 Panel I list the data of variables used for Board Size and Board Independence sample. Consistent with our hypothesis, we observe higher board size for non-overconfident CEOs and higher CEO Duality for overconfident CEOs. High board size indicates more corporate scrutiny and more CEO duality indicates lower board independence. For other variables, we find overconfident CEOs handle larger firms with high cashflows, stock returns, market reputation, sales growth and return on investment. The final sample comprises data for 2,806 CEOs, 1,879 firms and 7,585 firm-year observations for board size. For board independence, our sample consists for 2,806 CEOs, 1,879 firms and 7,593 firm-year observations.

Panel II list the statistics of variables used for age demographic of board analysis. Consistent with our prediction, we observe lower average age of board directors for

overconfident CEOs. Having younger people on the board incorporates favourable setting for risky investments and sometimes less supervising. For control variables, we find overconfident CEOs have small board size and lower board independence. Also, they manage larger companies with strong cash flows, stock returns, market repute, sales growth, and return on investment The final sample comprises data for 2,354 CEOs, 1,879 firms and 7,099 firm-year observations.

Panel III list the data of variables used to analyse frequency of Co-opted directors. Consistent with our expectation, overconfident CEOs have higher amount of co-option. Directors who have been co-opted are more inclined to pledge their allegiance to the CEO. Overconfident CEOs have smaller boards and less board independence, according to our findings. They also oversee larger businesses with stable cash flows, stock returns, market reputation, sales growth, and return on investment. The final sample comprises data for 2,805 CEOs, 1,879 firms and 4,254 firm-year observations.

[Table 1 from Appendix II (C) and Table 6 from Appendix II (D) here]

4.1.2. External Governance

Appendix II (D), table 6 Panel IV list the statistics of variables used to analyse Blockholders authority. Coherent with our hypothesis, overconfident CEOs have fewer number of blockholders and lower blockholders shareholdings. Blockholders are large shareholder who have the capacity and motivation to initiate scrutiny over CEOs decision, and thereby resulting to tighter governance. Overconfident CEOs have smaller boards and less board independence. They also manage larger companies with consistent cash flows, stock returns, market reputation, sales growth, and return on investment. Final sample comprises data for 862 CEOs, 1,879 firms and 2,269 firm-year observations.

Panel V list the statistics of variables used to investigate change of auditor. Consistence with our assumption, overconfident CEOs have frequent change of auditor from Big 4 to non-Big 4 firms. Big 4 accounting firms are more likely to conduct through

audit over firm investments, which might not be welcomed by overconfident CEOs. Also, overconfident CEOs have smaller boards and less board independence. They operate larger companies with steady cash flows, stock returns, market reputation, sales growth, and return on investment. The Final sample comprises data for 1,051 CEOs, 1,879 firms and 1,864 firm-year observations.

4.2. Regression Estimates

Our study aims to uncover the relationship between corporate governance determinants and CEO overconfidence and define the board structure for firms lead by them. Many academic studies on corporate governance are based on agency assumptions, and these models are likely to overlook the wide range of macro and micro implications. While the CEO has a significant involvement on board of directors and firm culture (Llopis et al., 2007) and Hambrick et al. (2008) proposed a behavioural science approach of the CEO to investigate corporate governance procedures; no prior studies have taken them into account. We incorporate internal and external elements of corporate governance structure and investigate their formation under the leadership of overconfident CEOs.

4.2.1. Internal Governance

The first component of internal governance, Board Size, shows negative significant relationship with overconfident CEOs using Negative Binomial Model. Confirming our hypothesis, we find an overconfident CEO has 11.40 percent smaller board size and in presence of CEO duality the size decreases by 8.50 percent. Therefore, we can conclude that overconfident CEOs prefer fewer directors on the board which in turn reduces noise and interference over CEOs decision. With regards to other control variables, board size increase with firm size, however larger board size does not provide higher Cash, BHAR, Tobin's Q, Sales growth or ROA. Our outcomes strengthen the literature (Benson et al.,

2011; Cannella et al., 2008) which argue that large board tend to ignore shareholder's demands and reduce firm value. Having fewer directors on board, overconfident CEOs therefore provides rationalization on increasing firm profitability.

Second, we investigate CEO Duality (absence of board independence) and observe positive significant relation among CEO overconfidence and CEO Duality. To test the hypotheses, a logistic regression model is used. When the outcome variable is nonmetric and dichotomous, this approach is regarded an appropriate analytical tool (Peng et al., 2002). Ordinary least squares (OLS) regression is challenging to analyse because the plot of this data is usually two parallel lines. As predicted by literature and our hypothesis, overconfident CEO are 7.5 percent more likely to be chairperson/president of the board. Holding top-tier dual roles in the firm gives the CEO more authority and power over corporate decisions and thus can extremely compromises with firm governance. Moreover, we find 1.2 percent smaller board size associated with the presence of CEO Duality, along with larger firms, Cash and BHAR. However, Tobin's Q, Sales growth and ROA is negatively related with the occurrence of duality.

We use average age of directors as a third component to analyse internal governance structure of firms headed by overconfident CEOs using Tobit regression Left-censored at 18. Verifying our hypothesis, we find overconfident CEOs have more younger directors on the board. As the literature suggests, younger directors are more confident and risk takers (Reyna, 2012). Overconfident CEOs find ease to work with younger directors as they are both to compatible with each other (Bernardo and Welch, 2001; Goel and Thakor, 2000 and Van den Steen, 2005). When controlling for other board characteristics, we find younger directors with increased CEO Duality and smaller board size. With regards to firm level control, younger directors are associated with higher Cashflow, Tobin's Q and Sales growth; however, they are common in smaller firms with lower BHAR and ROA.

[Table 2 from Appendix II (C) here]

For final component of internal governance, we investigate co-option under overconfident CEOs. Having more co-opted directors on the board would indicate more alliance and more management discretion granted to the CEO. In line with psychology literature, we find overconfident CEOs have 3.9 percent more co-option; and the results are robust after controlling for CEOs age and gender. Also, we observe co-option increases with CEO Duality (CEO being chairperson/president of the board) and decreases with board size. We can ague from the findings that having more co-option can be described as the board's ineffectiveness on overseeing the CEO. Co-option is the result of a director's aversion to scrutiny combined with a lack of independence on the board. For firm level control, we find co-option is linked with larger firms, Cash, Tobin's Q, Sales growth and ROA, but are negatively related with BHAR.

[Table 3 from Appendix II (C) here]

4.2.2. External Governance

To analyse the external factors of governance, we incorporate blockholders, both outside and officers, to assess the external monitoring over the executives. Firm specific information is considered more credible in the presence of blockholders (Gorton, Huang, and Kang, 2013) and this indicates higher quality of firm governance. Blockholders can exert additional monitoring over firm investments because of their substantial shareholding. Nevertheless, this additional enquiry is not welcomed by overconfident CEOs as we find that both blockholders shareholdings and numbers are substantially lower in firm lead by overconfident CEOs. We further investigate the structure by looking into outside and officer blockholders and we conclude that while both are negatively associated, officer blockholders are comparative more unpopular than outside blockholders. The relative preference of outside blockholders can be due to positive market response received after their acquisitions (Holderness and Sheehan, 1985). CEO Duality and board size display negative association with blockholders, more significantly for officer block. For firm level variables, we find lower number and percentage shareholdings for larger firms,

higher Cash, Tobin's Q and ROA. Literatures have verified that blockholders improve firm governance (Dechow et al., 1996 and Farber, 2005); however, we did not find any evidence for improved firm performance.

[Table 4 from Appendix II (C) here]

Next, we investigate the change of auditor from Big 4 to non-Big 4 in firms lead by an overconfident CEO. Due to optimistic bias in accounting judgment (Schrand and Zechman, 2012) and undermining accounting conservatism (Ahmed and Duellman, 2013), CEO overconfidence increases the likelihood of corporate misrepresentations. Larger accounting firms provide higher-quality audits because of their size, resources, standardized audit techniques, and more alternatives for subsequent partner evaluations (Dopuch and Simunic, 1980). This argument is further verified by Palm rose, 1988; Becker et al., 1998; Khurana and Raman, 2004 and Behn et al., 2008. In line with the discussion, we find overconfident CEOs are 5.5 percent more likely to change auditors from big 4 to non-Big 4 firms after they start out office. This conclusion falls in line with the literature suggesting that overconfident CEOs prefers minimal oversight. The robustness check for change auditor from Big 5 to non-Big 5 accounting firms also validates our hypothesis and shows 4.1 percent more change for firms headed by overconfident CEOs. For CEO Duality we find more change of auditor for Big 4, however board size shows less change of auditor from Big 4 and Big 5. Firm level variables show us higher change with larger, more cash positive, high Tobin's Q, Sales growth and ROA.

[Table 5 from Appendix II (C) here]

5. Conclusions

Corporate governance is affected by a variety of external and internal factors. Most study focuses on country-specific legislation and cultural norms (La Porta et al., 2000), or

on external variables such as media attention and stakeholder activism (Uysal and Tsetsura, 2015). Firm performance can also create pressure to share more information about corporate governance (Grove et al., 2011), and can sometimes force to comply to industry norms, demonstrate industry leadership to peers, or imitate others (Tang et al., 2019). Besides, less detectable elements such as organizational culture can have a big impact on the amount of transparency in business disclosures (Llopis et al., 2007). Corporate culture may be viewed as a subset of both formal and informal management control systems. Ferry and Ahrens (2017) argue that management controls not only reinforce corporate governance standards, but also modifies them. Control practices, such as behavioural aspects, are often researched qualitatively; nonetheless, qualitative studies account for a small fraction (less than 1%) of corporate governance studies. Mcnulty Zattoni and Douglas (2013) highlight the gap of top managements, i.e., CEOs behavioural study in unveiling governance composition. The inability of literature to provide definitive answers on the drivers of firm governance is partly due to the elimination of CEO attributes while studying corporate structure and governance.

Personal characteristics and behavioral biases, such as overconfidence, influence both information-provision incentives and investment decisions (Malmendier and Tate, 2005). Our research incorporates CEO overconfidence as one of numerous interrelated factors into a fundamental model for corporate governance reflection. There is little research on the impact of CEO overconfidence on governance processes (Parker, 2017). In this context, we combine data of publicly traded US firms from Execucomp, Compusat, CRSP, BoardEx and WRDS Audit Analytics from year 1996-2001 and analyze internal and external factors of corporate governance for firms under the leadership of overconfident CEOs.

We empirically test the theoretical implications of Harrison and Klein's (2007) diversity typology on board structure. The board of directors and its committees not only review and advise on company strategy, performance and risk, but they may also supply organizations with network connections and resources (Endrikat et al., 2020). According to resource dependence theory (Hillman and Dalziel, 2003), board characteristics, for

instance, access to networks and resources determine their influence on firm performance. This approach emphasizes that directors contribute a variety of resources and connections to the firm, and that board composition should be tailored to the firm's specific needs. When the firm's demands vary, the board composition gets modified over time (Hillman et al., 2009). In compared to larger and more mature organizations, small enterprises and firms in the early phases of their lifecycle may benefit more from the resources provided by the board. Former research has also found a link between an increase in the proportion of independent board members and internal control information weakness correction (Johnstone et al., 2011), and stock returns of firms previously accused of fraud (Farber, 2005). Because corporate governance determinants are so varied, establishing appropriate metrics to quantify the quality of corporate governance processes is a major challenge when doing research in this field (Bhagal et al., 2008). Although formal corporate governance mechanisms like board composition and meeting frequency are frequently used for evaluating corporate governance quality, there are also less studied informal mechanisms like managerial attitude and organizational culture that are likely to have a significant impact (Llopis et al., 2007). The board structure is a crucial component of corporate governance, and we investigate it in interest with CEO overconfidence. We look at how board size, independence, average age, co-option, blockholders, and auditor selection affect corporate governance for companies led by overconfident CEOs.

In numerous ways, this study aims at contributing to existing corporate governance literature, business practice, and public policy. First, it unites psychologists' and sociologists' ideas with a management and economic orientation, which helps theoretical understanding of board structure. Second, it empirically investigates co-option and blockholder policies, both of which are important components of a board. Third, while audit fees are studied before, the integration of Big 4 auditors and CEO overconfidence helps us present more thorough argument. With this study, we can clarify the obscurity surrounding firm governance for overconfident CEOs and provide empirically backed argument of their formation. We provide clarification for the unconventional corporate policies of overconfident CEOs (Malmendier et al., 2011) beyond individual perimeter by including the influence of board of directors. Firm corporate governance is likely to impact

firm performance and the choice of policies (Grove et al., 2011); and we investigate the board composition to understand governance of firms lead by overconfident CEOs. We conclude that governance under an overconfident CEOs appear to be less strong with smaller board size, lower board independence, younger directors and more co-opted directors as determinants for internal governance controls. For external mechanisms, we argue that overconfident CEOs have lower number of outsiders and officers blockholders with fewer percentage of shareholdings. Their comparative smaller blocks reduce their authority and dominance over firm decision making, hence compromising the external monitoring otherwise placed by blockholders. We further investigate the auditor's selection to determine the external inspection of governance and find the likelihood of shifting from Big 4 to non-Big 4 firms and Big 5 to non-Big 5 firms to limit the through audits (Khurana and Raman, 2004; Behn et al., 2008).

Our findings are robust by our best efforts to account for endogeneity. To account for biases induced by unobserved, firm-specific, time-invariant, omitted variables that are linked with control variables, we add firm and year fixed effects in all our base case regressions. However, endogeneity may still exist if the omitted variable is not firm-specific or fluctuates over time. To address this issue, we use different measures of CEO overconfidence (Appendix II (C)) and confirm the results. Like in almost any economic research the empirical findings are conditioned by sample and availability of information, we are as well limited to the data sources provided by the university. To achieve more conclusive conclusions, future studies should incorporate more data from Thomson-Reuters 13F Filings or Governance Quality Score from Institutional Shareholder Services (ISS). A future extension of this study could investigate the role of corporate social responsibility strategies as mediators.

[Table 6 and 7 from Appendix II (C) here]

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7. Tables

Table 1: Descriptive Statistics

This table presents summary statistics for Internal and External elements of corporate governance structure of firms used in the analysis. The details statistics of firm level variables are shown in Appendix II (D) Table 6. All variables are defined in Appendix II (B).

	Sample Frame (1996-2001)							
	Non-overconfident CEOs			*Overconfident CEOs*			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
Board Size (NOC= 4,313; OC=3,272)	5.210	5.000	0.825	5.077	5.000	0.709	0.133***	0.000***
CEO Duality (NOC= 4,313; OC=3,272)	0.851	1.000	0.356	0.915	1.000	0.279	-0.064***	0.000***
Board of Director's Age (NOC= 4,016; OC=3,083)	72.268	71.750	6.608	71.089	71.000	6.004	1.179***	0.750***
Co-opted Directors (NOC= 2,360; OC=1,894)	0.789	1.000	0.408	0.841	1.000	0.366	-0.052***	0.000***
Percentage shareholding of all Blockholders (NOC= 1,270; OC=999)	27.139	24.940	16.671	21.980	20.800	14.840	5.159***	4.140***
Number of all Blockholders (NOC= 1,270; OC=999)	2.844	3.000	1.671	2.371	2.000	1.537	0.473***	1.000***
Change of Auditor (NOC= 969; OC=895)	0.551	0.000	0.791	0.649	0.000	0.798	-0.098***	0.000***

Table 2: Regression Estimates and Marginal Effects for Board Size, CEO Duality and Board of Directors Age Demography for Overconfident CEOs

The table presents the results of Negative Binomial regression estimates (column 1i) and marginal effects (column 1ii) of Board Size, Logit regression estimates (column 2i) and marginal effects (column 2ii) of Board Independence (CEO Duality) and Tobit regression estimates (column 3) of Board of Directors average age on CEO overconfidence. Board size is the total number of directors on board for a firm year, Board Independence (CEO duality) is an indicator variable which takes the value 1 when CEOs are assigned as chairperson/president of the board, and 0 otherwise, and Board of Director Age Demographic is the mean age of all serving directors in that firm-year. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) *Board Size*	*(1ii)* *Marginal Effects*	*(2i)* *CEO Duality (Lack of Board Independence)*	*(2ii)* *Marginal Effects*	*(3)* *Board of Director's Age*
OC_GS67	-0.022*	-0.114*	0.712***	0.075***	-0.610***
	(-1.94)	(-1.94)	(9.04)	(8.98)	(-4.00)
CEO Duality	-0.017	-0.085	N/A	N/A	-0.091
	(-1.03)	(-1.03)			(-0.43)
Board Size	N/A	N/A	-0.118***	-0.012***	0.151*
			(-2.67)	(-2.67)	(1.65)
Log(sale)	0.030***	0.157***	0.107**	0.011**	0.678***
	(4.25)	(4.24)	(2.39)	(2.39)	(7.06)
Cash	-0.001	-0.004	0.017	0.002	-0.246***
	(-0.11)	(-0.11)	(0.38)	(0.38)	(-2.60)
BHAR	-0.003	-0.018	0.038	0.004	0.144**
	(-0.65)	(-0.65)	(1.05)	(1.05)	(2.05)
Tobin's Q	-0.001	-0.008	-0.120***	-0.013***	-0.522***
	(-0.22)	(-0.22)	(-3.07)	(-3.07)	(-5.89)
Sales growth	-0.004	-0.019	-0.129***	-0.014***	-0.344***
	(-0.62)	(-0.62)	(-3.56)	(-3.56)	(-4.41)
ROA	-0.011*	-0.055*	-0.007	-0.001	0.217**
	(-1.66)	(-1.66)	(-0.18)	(-0.18)	(2.51)

Constant	1.721***	N/A	2.341***	N/A	72.230***
	(19.15)		(9.87)		(55.81)
Observations	7,585	7,585	7,585	7,585	7,099
Pseudo R^2	0.003	N/A	N/A	N/A	0.037
Pearson Chi^2	N/A	N/A	0.581	N/A	N/A
Correctly Classified	N/A	N/A	0.879	N/A	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Regression Estimates and Marginal Effects for Co-option for Overconfident CEOs

The table presents the results of Logit regression estimates (column 1i,2i,3i,4i) and marginal effects (column 1ii,2ii,3ii,4ii) of Co-option on CEO overconfidence. Presence of Co-opted Directors is an indicator variable which takes the value 1 if there are co-opted directors in that firm-year and 0 otherwise. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) Co-opted Directors	*(1ii) Marginal Effects*	*(2i) Co-opted Directors*	*(2ii) Marginal Effects*	*(3i) Co-opted Directors*	*(3ii) Marginal Effects*	*(4i) Co-opted Directors*	*(4ii) Marginal Effects*
OC_GS67	0.261***	0.039***	0.265***	0.039***	0.260***	0.039***	0.267***	0.039***
	(3.08)	(3.08)	(2.97)	(2.98)	(3.06)	(3.07)	(2.98)	(2.99)
CEO Duality	0.305***	0.046***	0.310**	0.045**	0.304***	0.046***	0.311**	0.046**
	(2.66)	(2.67)	(2.30)	(2.30)	(2.66)	(2.66)	(2.31)	(2.32)
Board Size	-0.094*	-0.014*	-0.068	-0.010	-0.094*	-0.014*	-0.068	-0.010
	(-1.80)	(-1.80)	(-1.18)	(-1.18)	(-1.79)	(-1.80)	(-1.18)	(-1.18)
Log(sale)	0.082	0.012	0.055	0.008	0.081	0.012	0.055	0.008
	(1.64)	(1.64)	(1.03)	(1.03)	(1.62)	(1.62)	(1.04)	(1.04)
Cash	0.038	0.006	0.096*	0.014*	0.040	0.006	0.094	0.014
	(0.69)	(0.69)	(1.65)	(1.65)	(0.72)	(0.72)	(1.61)	(1.61)
BHAR	-0.025	-0.004	-0.040	-0.006	-0.025	-0.004	-0.040	-0.006
	(-0.60)	(-0.60)	(-0.90)	(-0.90)	(-0.59)	(-0.59)	(-0.90)	(-0.90)

Tobin's Q	0.015	0.002	0.025	0.004	0.014	0.002	0.026	0.004
	(0.29)	(0.29)	(0.46)	(0.46)	(0.27)	(0.27)	(0.48)	(0.48)
Sales growth	0.146***	0.022***	0.177***	0.026***	0.146***	0.022***	0.177***	0.026***
	(2.91)	(2.91)	(3.26)	(3.26)	(2.91)	(2.91)	(3.26)	(3.27)
ROA	0.004	0.001	-0.012	-0.002	0.005	0.001	-0.013	-0.002
	(0.09)	(0.09)	(-0.24)	(-0.24)	(0.09)	(0.09)	(-0.24)	(-0.24)
CEO's Age	N/A	N/A	0.039***	0.006***	N/A	N/A	0.040***	0.006***
			(6.79)	(6.85)			(6.81)	(6.88)
CEO's Gender	N/A	N/A	N/A	N/A	-0.156	-0.023	0.205	0.030
					(-0.52)	(-0.52)	(0.60)	(0.60)
Constant	1.597***	N/A	-0.659	N/A	1.754***	N/A	-0.877	N/A
	(5.37)		(-1.48)		(4.14)		(-1.52)	
Observations	4,254	4,254	3,901	3,901	4,254	4,254	3,901	3,901
Pearson Chi^2	0.413	N/A	0.489	N/A	0.491	N/A	N/A	N/A
Correctly Classified	0.812	N/A	0.817	N/A	0.817	N/A	N/A	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Regression Estimates for Blockholders for Overconfident CEOs

The table presents the results of regression estimates of Percentage Shareholdings and Number of all, outside and officer Blockholders on CEO overconfidence. Percentage shareholdings by Blockholders represents the percentage of firm stock owned by all (column 1), outside (column 3) and officer (column 5) blockholder in that firm-year. Number of Blockholders represent number of all (column 2), outside (column 4) and officer (column 6) blockholder in that firm-year. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) *Percentage held by all Blockholders*	*(2)* *Number of all Blockholders*	*(3)* *Percentage held by outside Blockholders*	*(4)* *Number of outside Blockholders*	*(5)* *Percentage held by officer Blockholders*	*(6)* *Number of officers Blockholders*
OC_GS67	-3.847***	-0.297***	-1.887***	-0.186***	-2.041***	-0.115***
	(-5.65)	(-4.21)	(-2.91)	(-2.64)	(-7.08)	(-5.69)
CEO Duality	-0.062	-0.083	0.051	-0.056	0.263	0.010
	(-0.07)	(-0.86)	(0.06)	(-0.57)	(0.66)	(0.36)
Board Size	-0.422	-0.045	0.146	-0.009	-0.567***	-0.049***
	(-1.07)	(-1.11)	(0.39)	(-0.23)	(-3.40)	(-4.17)
Log(sale)	-6.305***	-0.608***	-3.554***	-0.426***	-2.132***	-0.165***
	(-13.67)	(-12.73)	(-8.10)	(-8.90)	(-10.90)	(-12.13)
Cash	-0.771	-0.088*	-0.420	-0.066	0.283	0.039***
	(-1.62)	(-1.79)	(-0.93)	(-1.33)	(1.40)	(2.77)
BHAR	-0.087	-0.010	0.047	0.007	-0.087	-0.013
	(-0.27)	(-0.30)	(0.15)	(0.21)	(-0.64)	(-1.35)

Tobin's Q	-2.289***	-0.241***	-1.897***	-0.216***	-0.227	-0.012
	(-5.39)	(-5.49)	(-4.69)	(-4.89)	(-1.26)	(-0.95)
Sales growth	0.114	0.053	0.109	0.037	0.169	0.014
	(0.29)	(1.29)	(0.29)	(0.90)	(1.01)	(1.19)
ROA	-0.197	-0.089*	-1.080**	-0.143***	1.048***	0.076***
	(-0.44)	(-1.95)	(-2.55)	(-3.11)	(5.56)	(5.78)
Constant	29.769***	3.333***	24.374***	2.815***	3.414	0.244
	(3.79)	(4.10)	(3.26)	(3.45)	(1.02)	(1.05)
Observations	2,269	2,269	2,269	2,269	2,269	2,269
Adjusted R^2	0.349	0.321	0.248	0.261	0.335	0.362

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Regression Estimates and Marginal Effects for Change from Big 4 Auditor and Change from Big 5 Auditor for Overconfident CEOs

The table presents the results of regression estimates (column 1i, 2i) and marginal effects (column 1ii, 2ii) of Change of auditors on CEO overconfidence. Change of Auditor is an indicator variable takes the value 1 if the firm had change of auditor from Big 4 to non-Big 4 or Big 5 to non-Big 5 accounting firms after the CEO took office and 0 otherwise. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Big 4*	*(1ii)* *Marginal Effects*	*(2i)* *Big 5*	*(2ii)* *Marginal Effects*
OC_GS67	0.236**	0.055**	0.171*	0.041*
	(2.34)	(2.35)	(1.71)	(1.72)
CEO Duality	0.031	0.007	-0.063	-0.015
	(0.23)	(0.23)	(-0.48)	(-0.48)
Board Size	-0.076	-0.018	-0.106*	-0.025*
	(-1.30)	(-1.30)	(-1.82)	(-1.83)
Log(sale)	0.073	0.017	-0.022	-0.005
	(1.28)	(1.28)	(-0.39)	(-0.39)
Cash	0.172***	0.040***	0.213***	0.051***
	(3.34)	(3.38)	(4.04)	(4.10)
BHAR	-0.025	-0.006	-0.107**	-0.026**
	(-0.60)	(-0.60)	(-2.54)	(-2.56)
Tobin's Q	0.012	0.003	0.022	0.005
	(0.28)	(0.28)	(0.51)	(0.51)
Sales growth	0.109**	0.026**	0.157***	0.038***
	(2.32)	(2.33)	(3.32)	(3.36)
ROA	0.070	0.016	0.088*	0.021*
	(1.44)	(1.44)	(1.84)	(1.85)
Constant	-0.199	N/A	0.451	N/A

	(-0.59)		(1.35)	
Observations	1,864	1,864	1,864	1,864
Pearson Chi^2	0.339	N/A	0.342	N/A
Correctly Classified	0.606	N/A	0.613	N/A

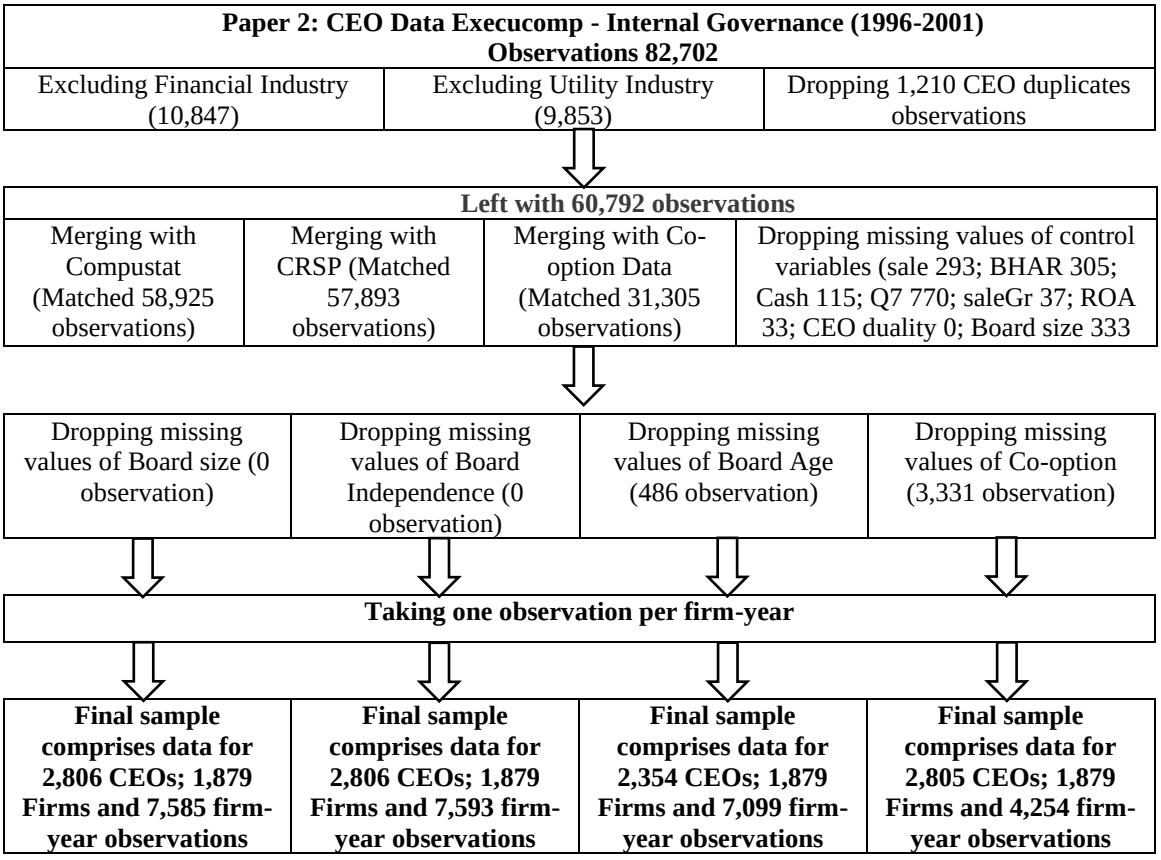
t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

8. Appendix

8.1. Appendix II (A): Data Filtering Process

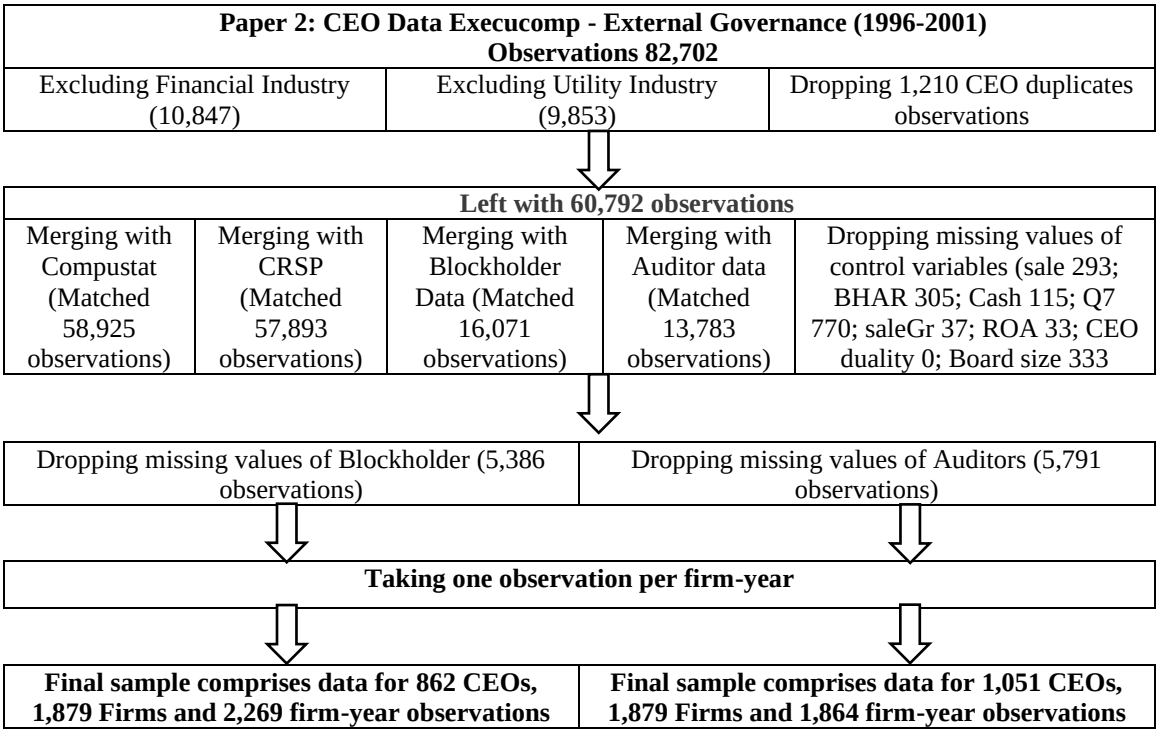
8.1.1. Panel I: Internal Governance

For our sample period of 1996-2001, we used Execucomp to obtain data on executive stock options. We excluded the financial and utility industries, and Duplicates for CEOs. We had 60,792 observations for CEOs at this point. We then merged this data with Compustat's financial and accounting variables, and stock returns from the Centre for Research in Security Prices (CRSP) database, using GVKEY and year. For co-option data, we use "*Coles, J.L., Daniel, N.D., and Naveen, L., 2014. Co-opted Boards. The Review of Financial Studies 27, 1751-1796*". Any missing data for control variables was discarded.



8.1.2. Panel II: External Governance

For our sample period of 1996-2001, we used Execucomp to obtain data on executive stock options. We excluded the financial and utility industries, and Duplicates for CEOs. We had 60,792 observations for CEOs at this point. We then merged this data with Compustat's financial and accounting variables, and stock returns from the Center for Research in Security Prices (CRSP) database, using GVKEY and year. We use Blockholders data from BoardEx and Auditors data from WRDS Audit Analytics. Any missing data for control variables was discarded.



8.2. Appendix II (B): Variable Definition

Variables	Description
Dependent variable	
Board size	Total number of directors on board for a firm year.
Board Independence (CEO duality)	Indicator variable which takes the value 1 when CEOs are assigned as chairperson/president of the board, and 0 otherwise.
Board of Director Age Demographic	The mean age of all serving directors in that firm-year
Presence of Co-opted Directors	Indicator variable which takes the value 1 if there are co-opted directors in that firm-year and 0 otherwise.
Percentage shareholdings by all Blockholders	Percentage of firm stock owned by all (affiliated, outside, ESOP, non-officer, officer) blockholder in that firm-year
Number of all Blockholders	Represent number of all (affiliated, outside, ESOP, non-officer, officer) blockholder in that firm-year
Percentage shareholdings by outside Blockholders	Percentage of firm stock owned by outside blockholder in that firm-year
Number of outside Blockholders	Represent number of outside blockholder in that firm-year
Percentage shareholdings by officer Blockholders	Percentage of firm stock owned by officer blockholder in that firm-year
Number of officer Blockholders	Represent number of officer blockholder in that firm-year
Change of Auditor	Indicator variable takes the value 1 if the firm had change of auditor from Big 4 to non-Big 4 or Big 5 to non-Big 5 accounting firms after the CEO took office and 0 otherwise.
Variables relating to CEO overconfidence (lagged values)	
OC_GS67	Indicator variable that takes a value of 1 for all CEO-years if the CEO postpones the exercise of vested options that are at least 67% in the money at least twice during the tenure, in any two years, or 0 otherwise.
OC_GS100	Indicator variable that takes a value of 1 for all CEO-years if the CEO postpones the exercise of vested options that are at least 100% in the money at least twice during the tenure, in any two years, and 0 otherwise.
OC_MT67	Indicator variable that takes a value of 1 after the first year, if a CEO postpones the exercise of vested options that are at least 67% in the money at least twice during the tenure, in any two years, or 0 otherwise.

OC_MT100	Indicator variable that takes a value of 1 after the first year, if a CEO postpones the exercise of vested options that are at least 100% in the money at least twice during the tenure, in any two years, or 0 otherwise.
Control variables (lagged values)	
Log(sale)	Natural logarithm of sales (sale) US dollars.
Cash	Ratio of cash (ch) to total assets (at).
BHAR	Buy-and-hold return over the fiscal year.
Tobin's Q	Ratio of market value (at+(csho*prcc_f)- ceq- pstkl- txdb) to book value (at) of firm.
Sales growth	Log transformation of sales (sale) divided by prior-year sales.
ROA	Ratio of operating income before depreciation (oibdp) to total assets (at).
CEO's Age	CEO's age in years
CEO's Gender	Indicator variables takes the value 1 is the CEO is male, and o otherwise.

8.3. Appendix II (C)

Table 6: Descriptive Statistics (Sample Wise)

Panel I: Board Size and Board Independence (CEO Duality)

This table presents summary statistics for the Board Size, Board Independence (CEO Duality) and firm level variables used in our analysis. The final sample consists of 2,806 CEOs, 1,879 firms and 7,585 (Board Size) and 7,593 (Board Independence) firm-year observations between 1996-2001. All variables are defined in Appendix II (B).

	Sample Frame (1996-2001)							
	Non-overconfident CEOs (N= 4,313)			*Overconfident CEOs* (N= 3,272)			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
Board Size	5.210	5.000	0.825	5.077	5.000	0.709	0.133***	0.000***
CEO Duality	0.851	1.000	0.356	0.915	1.000	0.279	-0.064***	0.000***
Sales	2987.815	951.773	6088.737	3892.893	976.302	8025.309	-905.078***	-24.529***
Cash	0.078	0.036	0.101	0.099	0.050	0.117	-0.021***	-0.014***
BHAR	-0.101	-0.068	0.371	-0.037	-0.016	0.423	-0.064**	-0.052***
Tobin's Q	1.998	1.481	1.652	2.863	2.082	2.244	-0.865***	-0.601***
Sales Growth	0.101	0.059	0.270	0.180	0.126	0.275	-0.079***	-0.067***
ROA	0.140	0.143	0.113	0.165	0.169	0.114	-0.025***	-0.026***

Panel II: Board of Director Age Demographic

This table presents summary statistics for the Board Directors Age Demography and firm level variables used in the analysis. The final sample consists of 2,354 CEOs, 1,879 firms and 7,099 firm-year observations between 1996-2001. All variables are defined in Appendix II (B).

	Sample Frame (1996-2001)							
	Non-overconfident CEOs (N= 4,016)			*Overconfident CEOs* (N= 3,083)			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
Board of Director's Age	72.268	71.750	6.608	71.089	71.000	6.004	1.179***	0.750***
Board Size	5.224	5.000	0.822	5.090	5.000	0.700	0.134**	0.000**
CEO Duality	0.849	1.000	0.358	0.911	1.000	0.284	-0.062***	0.000***
Sales	3068.164	1004.362	6187.013	4052.672	1019.584	8179.499	-984.508***	-15.222***
Cash	0.077	0.036	0.099	0.097	0.049	0.115	-0.020***	-0.013***
BHAR	-0.099	-0.065	0.372	-0.034	-0.014	0.423	-0.065***	-0.051***
Tobin's Q	2.011	1.500	1.643	2.873	2.091	2.258	-0.862***	-0.591***
Sales Growth	0.101	0.060	0.267	0.182	0.126	0.272	-0.081***	-0.066***
ROA	0.142	0.144	0.111	0.167	0.171	0.111	-0.025***	-0.027***

Panel III: Presence of Co-opted Directors

This table presents summary statistics for Co-opted Directors and firm level variables used in the analysis. The final sample consists of 2,805 CEOs, 1,879 firms and 4,254 firm-year observations between 1996-2001. All variables are defined in Appendix II (B).

	Sample Frame (1996-2001)							
	Non-overconfident CEOs (N= 2,360)			*Overconfident CEOs* (N= 1,894)			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
Co-opted Directors	0.789	1.000	0.408	0.841	1.000	0.366	-0.052***	0.000***
Board Size	5.234	5.000	0.788	5.115	5.000	0.697	0.119***	0.000***
CEO Duality	0.852	1.000	0.355	0.913	1.000	0.281	-0.061***	0.000***
Sales	3645.946	1331.968	6792.757	5094.970	1324.133	9261.550	-1449.024***	7.835***
Cash	0.066	0.029	0.088	0.090	0.044	0.109	-0.024***	-0.015***

BHAR	-0.092	-0.052	0.354	-0.050	-0.019	0.423	-0.042***	-0.033***
Tobin's Q	1.902	1.435	1.568	2.899	2.096	2.284	-0.997***	-0.661***
Sales Growth	0.070	0.042	0.239	0.145	0.103	0.248	-0.075***	-0.061***
ROA	0.147	0.143	0.099	0.170	0.173	0.109	-0.023***	-0.030***

Panel IV: Percentage Shareholding and Number of Blockholders

This table presents summary statistics for Blockholders and firm level variables used in the analysis. The final sample consists of 862 CEOs, 1,879 firms and 2,269 firm-year observations between 1996-2001. All variables are defined in Appendix II (B).

	Sample Frame (1996-2001)							
	Non-overconfident CEOs (N=1,270)			*Overconfident CEOs* (N=999)			*Difference*	
	Mean	*Median*	*Standard Deviatio*	*Mean*	*Median*	*Standard Deviatio*	*Mean*	*Median*
Percentage shareholdings of all Blockholders	27.139	24.940	16.671	21.980	20.800	14.840	5.159***	4.140***
Number of all Blockholders	2.844	3.000	1.671	2.371	2.000	1.537	0.473***	1.000***
Sales	3564.504	1174.454	7102.620	5045.543	1400.292	9251.775	-1481.039***	-225.838***
Cash	0.066	0.033	0.082	0.080	0.040	0.099	-0.014***	-0.007***
BHAR	-0.078	-0.043	0.326	-0.054	-0.017	0.392	-0.024***	-0.026***
Tobin's Q	1.879	1.455	1.515	2.720	2.053	2.035	-0.841***	-0.598***
Sales growth	0.060	0.040	0.218	0.128	0.090	0.220	-0.068***	-0.050***
ROA	0.146	0.142	0.095	0.174	0.174	0.101	-0.028***	-0.032***
Board size	5.184	5.000	0.859	5.084	5.000	0.720	0.100***	0.000***
CEO duality	0.853	1.000	0.354	0.923	1.000	0.267	-0.070***	0.000***

Panel V: Change of Auditor

This table presents summary statistics for Change of Auditors and firm level variables used in the analysis. The final sample consists of 1,051 CEOs; 1,879 Firms and 1,864 firm-year observations between 1996-2001. All variables are defined in Appendix II (B).

Sample Frame (1996-2001)								
	Non-overconfident CEOs (N=969)			*Overconfident CEOs* (N=895)			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
Change of Auditor	0.551	0.000	0.791	0.649	0.000	0.798	-0.098***	0.000***
Sales	2679.724	804.960	6083.758	3655.237	731.611	8177.587	-975.513***	73.349***
Cash	0.108	0.056	0.121	0.134	0.085	0.135	-0.026***	-0.029***
BHAR	-0.129	-0.079	0.436	-0.053	-0.020	0.488	-0.076***	-0.059***
Tobin's Q	2.417	1.578	2.276	3.813	2.695	2.992	-1.396***	-1.117***
Sales growth	0.127	0.078	0.318	0.221	0.159	0.300	-0.094**	-0.081**
ROA	0.126	0.133	0.131	0.156	0.166	0.128	-0.030***	-0.033***
Board size	5.237	5.000	0.870	5.042	5.000	0.796	0.195***	0.000***
CEO duality	0.798	1.000	0.402	0.901	1.000	0.299	-0.103***	0.000***

Table 7: Robustness Check for Internal Governance Using Different Overconfidence Measure

Table 7, panel I depicts the study analysis (column 1i) and marginal effects (column 1ii) of Board Size, regression estimates (column 2i) and marginal effects (column 2ii) of Board Independence (CEO Duality) and regression estimates (column 3) of Board of Directors average age for internal corporate governance analysis of firms headed by overconfident CEOs. As a robustness check, we use Galasso and Simcoe (2011) with 100% in-the-money to measure CEO overconfidence. Confirming our hypothesis, we find an overconfident CEO has 10.60 percent smaller board size and in presence of CEO duality the size decreases by 8.90 percent. Similar to our initial findings, board size increase with firm size, however, is not accompanied by higher Cash, BHAR, Tobin's Q, Sales growth or ROA.

Column 2i and 2ii illustrates the regression estimates and average marginal effects of CEO Duality (absence of board independence). Validating our results, overconfident CEO are 7.1 percent more likely to be chairperson/president of the board. Smaller board size contributes to 1.3 percent more chances of the presence of CEO Duality, along with larger firms, Cash and BHAR. However, Tobin's Q, Sales growth and ROA is negatively related with the existence of duality.

Column 3 lists the estimates of Directors Age Demography of firms lead by overconfident CEOs. Similar to our base results, we find overconfident CEOs have younger directors on the board. In line with other board characteristics, we find younger directors with increased presence of CEO Duality and smaller board size. For firm level control, younger directors are associated with higher Cashflow, Tobin's Q and Sales growth; however, they are common in smaller firms with lower BHAR and ROA.

Panel I: Regression Estimates and Marginal Effects for Board Size, CEO Duality and Board of Directors Age Demography for Overconfident CEOs Using Galasso and Simcoe (2011) With 100% in-the-money

The table presents the results of Negative Binomial Model regression estimates (column 1i) and marginal effects (column 1ii) of Board Size; Logit regression estimates (column 2i) and marginal effects (column 2ii) of Board Independence (CEO Duality); and Tobit regression Left-censored at 18 estimates (column 3) of Board of Directors average age on CEO overconfidence. Board size is the total number of directors on board for a firm year, Board Independence (CEO duality) is an indicator variable which takes the value 1 when CEOs are assigned as chairperson/president of the board, and 0 otherwise, and Board of Director Age Demographic is the mean age of all serving directors in that firm-year. A CEO is considered overconfident

if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) *Board Size*	*(1ii)* *Marginal Effects*	*(2i)* *Board Independence*	*(2ii)* *Marginal Effects*	*(3)* *Board of Director's Age*
OC_GS100	-0.021*	-0.106*	0.675***	0.071***	-0.723***
	(-1.68)	(-1.68)	(7.82)	(7.79)	(-4.47)
CEO Duality	-0.017	-0.089	N/A	N/A	-0.091
	(-1.08)	(-1.08)			(-0.43)
Board Size	N/A	N/A	-0.127***	-0.013***	0.152*
			(-2.86)	(-2.86)	(1.67)
Log(sale)	0.030***	0.155***	0.117***	0.012***	0.671***
	(4.20)	(4.20)	(2.63)	(2.63)	(6.99)
Cash	-0.001	-0.003	0.008	0.001	-0.237**
	(-0.08)	(-0.08)	(0.19)	(0.19)	(-2.50)
BHAR	-0.004	-0.019	0.046	0.005	0.138**
	(-0.70)	(-0.70)	(1.28)	(1.28)	(1.97)
Tobin's Q	-0.001	-0.007	-0.119***	-0.013***	-0.509***
	(-0.21)	(-0.21)	(-3.03)	(-3.03)	(-5.72)
Sales growth	-0.004	-0.019	-0.127***	-0.013***	-0.342***
	(-0.64)	(-0.64)	(-3.51)	(-3.51)	(-4.39)
ROA	-0.011*	-0.055*	-0.006	-0.001	0.224***
	(-1.66)	(-1.66)	(-0.16)	(-0.16)	(2.59)
Constant	1.721***	N/A	2.460***	N/A	72.259***
	(19.15)		(10.39)		(55.85)
Observations	7,585	7,585	7,585	7,585	7,099
Pseudo R^2	0.003	N/A	N/A	N/A	0.037
Pearson Chi^2	N/A	N/A	0.607	N/A	N/A
Correctly Classified	N/A	N/A	0.879	N/A	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7, panel II depicts the estimates (column 1i) and marginal effects (column 1ii) of Board Size, regression estimates (column 2i) and marginal effects (column 2ii) of Board Independence (CEO Duality) and regression estimates (column 3) of Board of Directors average age for internal corporate governance of firms headed by overconfident CEOs. As a robustness check of main analysis, we use Malmendier and Tate (2005) with 67% in-the-money to measure CEO overconfidence. Confirming our hypothesis, we find an overconfident CEO has 8.70 percent smaller board size and in presence of CEO duality the size decreases by 9.20 percent. Similar to our initial findings, board size increase with firm size, however, is not accompanied by higher Cash, BHAR, Tobin's Q, Sales growth or ROA.

Column 2i and 2ii illustrates the regression estimates and average marginal effects of CEO Duality (absence of board independence). Validating our results, overconfident CEO are 7.1 percent more likely to be chairperson/president of the board. Smaller board size contributes to 1.3 percent more chances of the presence of CEO Duality, along with larger firms, Cash and BHAR. However, Tobin's Q, Sales growth and ROA is negatively related with the existence of duality.

Column 3 lists the structure of Directors Age Demography of firms lead by overconfident CEOs. Similar to our base results, we find overconfident CEOs have younger directors on the board. For firm level control, younger directors are associated with higher Cashflow, Tobin's Q and Sales growth; however, they are common in smaller firms with lower BHAR and ROA.

Panel II: Regression Estimates and Marginal Effects for Board Size, CEO Duality and Board of Directors Age Demography for Overconfident CEOs Using Malmendier and Tate (2005) with 67% in-the-money

The table presents the results of Negative Binomial Model regression estimates (column 1i) and marginal effects (column 1ii) of Board Size; Logit regression estimates (column 2i) and marginal effects (column 2ii) of Board Independence (CEO Duality); and Tobit regression Left-censored at 18 estimates (column 3) of Board of Directors average age on CEO overconfidence. Board size is the total number of directors on board for a firm year, Board Independence (CEO duality) is an indicator variable which takes the value 1 when CEOs are assigned as chairperson/president of the board, and 0 otherwise, and Board of Director Age Demographic is the mean age of all serving directors in that firm-year. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the

firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) *Board Size*	*(1ii)* *Marginal Effects*	*(2i)* *Board Independence*	*(2ii)* *Marginal Effects*	*(3)* *Board of Director's Age*
OC_MT67	-0.017	-0.087	0.674***	0.071***	-1.408***
	(-1.44)	(-1.44)	(7.92)	(7.88)	(-9.09)
CEO Duality	-0.018	-0.092	N/A	N/A	0.002
	(-1.12)	(-1.12)			(0.01)
Board Size	N/A	N/A	-0.127***	-0.013***	0.137
			(-2.86)	(-2.86)	(1.50)
Log(sale)	0.030***	0.157***	0.102**	0.011**	0.725***
	(4.25)	(4.25)	(2.31)	(2.31)	(7.57)
Cash	-0.001	-0.004	0.022	0.002	-0.246***
	(-0.12)	(-0.12)	(0.51)	(0.51)	(-2.61)
BHAR	-0.004	-0.019	0.043	0.005	0.149**
	(-0.70)	(-0.70)	(1.20)	(1.20)	(2.13)
Tobin's Q	-0.001	-0.007	-0.126***	-0.013***	-0.430***
	(-0.20)	(-0.20)	(-3.21)	(-3.21)	(-4.84)
Sales growth	-0.004	-0.020	-0.123***	-0.013***	-0.329***
	(-0.68)	(-0.68)	(-3.39)	(-3.39)	(-4.25)
ROA	-0.011*	-0.057*	0.003	0.000	0.220**
	(-1.74)	(-1.74)	(0.07)	(0.07)	(2.57)
Constant	1.719***	N/A	2.452***	N/A	72.376***
	(19.13)		(10.36)		(56.23)
Observations	7,585	7,585	7,585	7,585	7,099
Pseudo R^2	0.003	N/A	N/A	N/A	0.038
Pearson Chi^2	N/A	N/A	0.587	N/A	N/A
Correctly Classified	N/A	N/A	0.879	N/A	N/A

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7, panel III depicts the estimates (column 1i) and marginal effects (column 1ii) of Board Size, regression estimates (column 2i) and marginal effects (column 2ii) of Board Independence (CEO Duality)

and regression estimates (column 3) of Board of Directors average age for internal corporate governance of firms headed by overconfident CEOs. As a robustness check of main analysis, we use Malmendier and Tate (2005) with 100% in-the-money to measure CEO overconfidence. Confirming our hypothesis, we find an overconfident CEO has 7.90 percent smaller board size and in presence of CEO duality the size decreases by 9.50 percent. Similar to our initial findings, board size increase with firm size, however, is not accompanied by higher Cash, BHAR, Tobin's Q, Sales growth or ROA.

Column 2i and 2ii illustrates the regression estimates, odds ratio and average marginal effects of CEO Duality (absence of board independence). Validating our results, overconfident CEO are 6.9 percent more likely to be chairperson/president of the board. Smaller board size contributes to 1.4 percent more chances of the presence of CEO Duality, along with larger firms, Cash and BHAR. However, Tobin's Q, Sales growth and ROA is negatively related with the existence of duality.

Column 3 lists the structure of Directors Age Demography of firms lead by overconfident CEOs. Similar to our base results, we find overconfident CEOs have younger directors on the board. For firm level control, younger directors are associated with higher Cashflow, Tobin's Q and Sales growth; however, they are common in smaller firms with lower BHAR and ROA.

Panel III: Regression Estimates and Marginal Effects for Board Size, CEO Duality and Board of Directors Age Demography for Overconfident CEOs Using Malmendier and Tate (2005) with 100% in-the-money

The table presents the results of Negative Binomial Model regression estimates (column 1i) and marginal effects (column 1ii) of Board Size; Logit regression estimates (column 2i) and marginal effects (column 2ii) of Board Independence (CEO Duality); and Tobit regression Left-censored at 18 estimates (column 3) of Board of Directors average age on CEO overconfidence. Board size is the total number of directors on board for a firm year, Board Independence (CEO duality) is an indicator variable which takes the value 1 when CEOs are assigned as chairperson/president of the board, and 0 otherwise, and Board of Director Age Demographic is the mean age of all serving directors in that firm-year. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) *Board Size*	*(1ii)* *Marginal Effects*	*(2i)* *Board Independence*	*(2ii)* *Marginal Effects*	*(3)* *Board of Director's Age*
OC_MT100	-0.015	-0.079	0.652***	0.069***	-1.570***
	(-1.19)	(-1.19)	(6.87)	(6.84)	(-9.28)
CEO Duality	-0.019	-0.095	N/A	N/A	-0.016
	(-1.16)	(-1.16)			(-0.08)
Board Size	N/A	N/A	-0.134***	-0.014***	0.145
			(-3.01)	(-3.01)	(1.59)
Log(sale)	0.030***	0.155***	0.113**	0.012**	0.701***
	(4.21)	(4.20)	(2.55)	(2.55)	(7.33)
Cash	-0.001	-0.003	0.015	0.002	-0.228**
	(-0.10)	(-0.10)	(0.34)	(0.34)	(-2.42)
BHAR	-0.004	-0.020	0.051	0.005	0.132*
	(-0.73)	(-0.73)	(1.40)	(1.40)	(1.90)
Tobin's Q	-0.001	-0.008	-0.123***	-0.013***	-0.412***
	(-0.22)	(-0.22)	(-3.12)	(-3.11)	(-4.62)
Sales growth	-0.004	-0.021	-0.122***	-0.013***	-0.331***
	(-0.69)	(-0.69)	(-3.35)	(-3.35)	(-4.28)
ROA	-0.011*	-0.057*	-0.001	-0.000	0.233***
	(-1.74)	(-1.74)	(-0.00)	(-0.00)	(2.72)
Constant	1.719***	N/A	2.543***	N/A	72.385***
	(19.13)		(10.76)		(56.25)
Observations	7,585	7,585	7,585	7,585	7,099
Pseudo R^2	0.003	N/A	N/A	N/A	0.038
Pearson Chi^2	N/A	N/A	0.577	N/A	N/A
Correctly Classified	N/A	N/A	0.879	N/A	N/A

t statistics in parentheses
** p < 0.10, ** p < 0.05, *** p < 0.01*

Table 7, panel IV depicts the analysis of Co-opted Directors for internal corporate governance of firms headed by overconfident CEOs. As a robustness check of main analysis, we use Galasso and Simcoe (2011) with 100% in-the-money to measure CEO overconfidence. Confirming our past results, we find overconfident CEOs have 2.1 percent more co-option; and the results are stronger after controlling for CEOs age and gender. We further observe co-option increases with CEO Duality (CEO being chairperson/president of the board) and decreases with board size. For firm level control, we find co-option is linked with larger firms, Cash, Tobin's Q, Sales growth and ROA, but are negatively related with BHAR.

Panel IV: Regression Estimates and Marginal Effects for Co-option for Overconfident CEOs Using Galasso and Simcoe (2011) with 100% in-the-money

The table presents the results of Logit regression estimates (column 1i,2i,3i,4i) and marginal effects (column 1ii,2ii,3ii,4ii) of Co-option on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Presence of Co-opted Directors is an indicator variable which takes the value 1 if there are co-opted directors in that firm-year and 0 otherwise. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) Co-opted Directors	*(1ii) Marginal Effects*	*(2i) Co-opted Directors*	*(2ii) Marginal Effects*	*(3i) Co-opted Directors*	*(3ii) Marginal Effects*	*(4i) Co-opted Directors*	*(4ii) Marginal Effects*
OC_GS100	0.141	0.021	0.168*	0.025*	0.139	0.021	0.170*	0.025*
	(1.55)	(1.55)	(1.76)	(1.76)	(1.53)	(1.53)	(1.78)	(1.78)
CEO Duality	0.328***	0.050***	0.323**	0.047**	0.327***	0.049***	0.325**	0.048**
	(2.87)	(2.87)	(2.40)	(2.41)	(2.86)	(2.87)	(2.41)	(2.42)
Board Size	-0.100*	-0.015*	-0.072	-0.011	-0.099*	-0.015*	-0.072	-0.011
	(-1.91)	(-1.91)	(-1.25)	(-1.25)	(-1.90)	(-1.90)	(-1.25)	(-1.25)

Log(sale)	0.088*	0.013*	0.059	0.009	0.087*	0.013*	0.060	0.009
	(1.77)	(1.77)	(1.12)	(1.12)	(1.75)	(1.75)	(1.14)	(1.14)
Cash	0.040	0.006	0.096	0.014	0.042	0.006	0.093	0.014
	(0.73)	(0.73)	(1.64)	(1.64)	(0.76)	(0.76)	(1.59)	(1.60)
BHAR	-0.021	-0.003	-0.035	-0.005	-0.021	-0.003	-0.035	-0.005
	(-0.50)	(-0.50)	(-0.80)	(-0.80)	(-0.49)	(-0.49)	(-0.80)	(-0.80)
Tobin's Q	0.027	0.004	0.035	0.005	0.026	0.004	0.036	0.005
	(0.52)	(0.52)	(0.64)	(0.64)	(0.51)	(0.51)	(0.66)	(0.66)
Sales growth	0.152***	0.023***	0.182***	0.027***	0.152***	0.023***	0.182***	0.027***
	(3.02)	(3.02)	(3.34)	(3.35)	(3.02)	(3.02)	(3.35)	(3.35)
ROA	0.006	0.001	-0.010	-0.002	0.006	0.001	-0.011	-0.002
	(0.13)	(0.13)	(-0.20)	(-0.20)	(0.13)	(0.13)	(-0.21)	(-0.21)
Executive's Age	N/A	N/A	0.040***	0.006***	N/A	N/A	0.040***	0.006***
			(6.83)	(6.89)			(6.85)	(6.92)
Gender	N/A	N/A	N/A	N/A	-0.163	-0.025	0.204	0.030
					(-0.54)	(-0.54)	(0.60)	(0.60)
Constant	1.670***	N/A	-0.605	N/A	1.835***	N/A	-0.823	N/A
	(5.62)		(-1.35)		(4.32)		(-1.43)	
Observations	4,254	4,254	3,901	3,901	4,254	4,254	3,901	3,901
Pearson Chi²	0.412	N/A	0.471	N/A	0.472	N/A	N/A	N/A
Correctly Classified	0.812	N/A	0.817	N/A	0.817	N/A	N/A	N/A

t statistics in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

Table 7, panel IV depicts the analysis of Co-opted Directors for internal corporate governance of firms headed by overconfident CEOs. As a robustness check of main analysis, we use Malmendier and Tate (2005) with 67% in-the-money to measure CEO overconfidence. Confirming our past results, we find overconfident CEOs have 5.5 percent more co-option; and the results are robust after controlling for CEOs age and gender. We further observe co-option increases with CEO Duality (CEO being chairperson/president of the board) and decreases with board size. For firm level control, we find co-option is linked with larger firms, Cash, Tobin's Q, Sales growth and ROA, but are negatively related with BHAR.

Panel IV: Regression Estimates and Marginal Effects for Co-option for Overconfident CEOs Using Malmendier and Tate (2005) with 67% in-the-money

The table presents the results of regression estimates (column 1i,2i,3i,4i) and marginal effects (column 1ii,2ii,3ii,4ii) of Co-option on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Presence of Co-opted Directors is an indicator variable which takes the value 1 if there are co-opted directors in that firm-year and 0 otherwise. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) Co-opted Directors	*(1ii) Marginal Effects*	*(2i) Co-opted Directors*	*(2ii) Marginal Effects*	*(3i) Co-opted Directors*	*(3ii) Marginal Effects*	*(4i) Co-opted Directors*	*(4ii) Marginal Effects*
OC_MT67	0.365***	0.055***	0.352***	0.052***	0.364***	0.055***	0.353***	0.052***
	(4.18)	(4.19)	(3.84)	(3.85)	(4.17)	(4.18)	(3.85)	(3.86)
CEO Duality	0.289**	0.044**	0.302**	0.044**	0.288**	0.043**	0.303**	0.044**
	(2.52)	(2.53)	(2.24)	(2.24)	(2.52)	(2.52)	(2.25)	(2.25)
Board Size	-0.091*	-0.014*	-0.064	-0.009	-0.090*	-0.014*	-0.064	-0.009
	(-1.74)	(-1.74)	(-1.11)	(-1.11)	(-1.73)	(-1.73)	(-1.12)	(-1.12)

Log(sale)	0.081	0.012	0.054	0.008	0.080	0.012	0.055	0.008
	(1.61)	(1.61)	(1.03)	(1.03)	(1.59)	(1.60)	(1.04)	(1.04)
Cash	0.038	0.006	0.097*	0.014*	0.040	0.006	0.095	0.014
	(0.69)	(0.69)	(1.66)	(1.67)	(0.72)	(0.72)	(1.62)	(1.62)
BHAR	-0.023	-0.003	-0.038	-0.006	-0.023	-0.003	-0.038	-0.006
	(-0.55)	(-0.55)	(-0.85)	(-0.85)	(-0.54)	(-0.54)	(-0.85)	(-0.85)
Tobin's Q	0.001	0.000	0.013	0.002	0.001	0.000	0.014	0.002
	(0.03)	(0.03)	(0.23)	(0.23)	(0.01)	(0.01)	(0.25)	(0.25)
Sales growth	0.142***	0.021***	0.174***	0.025***	0.142***	0.021***	0.175***	0.026***
	(2.84)	(2.84)	(3.20)	(3.21)	(2.84)	(2.84)	(3.21)	(3.21)
ROA	0.004	0.001	-0.013	-0.002	0.004	0.001	-0.013	-0.002
	(0.08)	(0.08)	(-0.24)	(-0.24)	(0.08)	(0.08)	(-0.25)	(-0.25)
Executive's Age	N/A	N/A	0.039***	0.006***	N/A	N/A	0.039***	0.006***
			(6.71)	(6.77)			(6.73)	(6.80)
Gender	N/A	N/A	N/A	N/A	-0.149	-0.022	0.208	0.030
					(-0.50)	(-0.50)	(0.61)	(0.61)
Constant	1.565***	N/A	-0.668	N/A	1.716***	N/A	-0.890	N/A
	(5.28)		(-1.50)		(4.05)		(-1.55)	
Observations	4,254	4,254	3,901	3,901	42,54	4,254	3,901	3,901
Pearson Chi²	0.416	N/A	0.508	N/A	0.511	N/A	N/A	N/A
Correctly Classified	0.812	N/A	0.817	N/A	0.817	N/A	N/A	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7, panel IV depicts the analysis of Co-opted Directors for internal corporate governance of firms headed by overconfident CEOs. As a robustness check, we use Malmendier and Tate (2005) with 100% in-the-money to measure CEO overconfidence. Confirming our past results, we find overconfident CEOs have 3.9 percent more co-option; and the results are stronger after controlling for CEOs age and gender. We further observe co-option increases

with CEO Duality (CEO being chairperson/president of the board) and decreases with board size. For firm level control, we find co-option is linked with larger firms, Cash, Tobin's Q, Sales growth and ROA, but are negatively related with BHAR.

Panel IV: Regression Estimates and Marginal Effects for Co-option for Overconfident CEOs Using Malmendier and Tate (2005) with 100% in-the-money

The table presents the results of regression estimates (column 1i,2i,3i,4i) and marginal effects (column 1ii,2ii,3ii,4ii) of Co-option on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Presence of Co-opted Directors is an indicator variable which takes the value 1 if there are co-opted directors in that firm-year and 0 otherwise. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) Co-opted Directors	*(1ii) Marginal Effects*	*(2i) Co-opted Directors*	*(2ii) Marginal Effects*	*(3i) Co-opted Directors*	*(3ii) Marginal Effects*	*(4i) Co-opted Directors*	*(4ii) Marginal Effects*
OC_MT100	0.255***	0.039***	0.271***	0.040***	0.254***	0.038***	0.273***	0.040***
	(2.66)	(2.67)	(2.68)	(2.69)	(2.65)	(2.65)	(2.70)	(2.70)
CEO Duality	0.317***	0.048***	0.317**	0.046**	0.316***	0.048***	0.318**	0.047**
	(2.77)	(2.78)	(2.36)	(2.36)	(2.77)	(2.77)	(2.37)	(2.37)
Board Size	-0.097*	-0.015*	-0.069	-0.010	-0.097*	-0.015*	-0.070	-0.010
	(-1.87)	(-1.87)	(-1.20)	(-1.20)	(-1.86)	(-1.86)	(-1.21)	(-1.21)
Log(sale)	0.088*	0.013*	0.060	0.009	0.087*	0.013*	0.061	0.009
	(1.77)	(1.77)	(1.13)	(1.13)	(1.75)	(1.75)	(1.15)	(1.15)
Cash	0.036	0.005	0.093	0.014	0.038	0.006	0.091	0.013

	(0.66)	(0.66)	(1.60)	(1.60)	(0.69)	(0.69)	(1.56)	(1.56)
BHAR	-0.019	-0.003	-0.033	-0.005	-0.018	-0.003	-0.033	-0.005
	(-0.44)	(-0.44)	(-0.73)	(-0.73)	(-0.43)	(-0.43)	(-0.74)	(-0.74)
Tobin's Q	0.013	0.002	0.022	0.003	0.013	0.002	0.024	0.003
	(0.26)	(0.26)	(0.41)	(0.41)	(0.25)	(0.25)	(0.43)	(0.43)
Sales growth	0.147***	0.022***	0.178***	0.026***	0.147***	0.022***	0.178***	0.026***
	(2.93)	(2.94)	(3.27)	(3.28)	(2.93)	(2.94)	(3.28)	(3.28)
ROA	0.005	0.001	-0.013	-0.002	0.005	0.001	-0.013	-0.002
	(0.09)	(0.09)	(-0.24)	(-0.24)	(0.10)	(0.10)	(-0.25)	(-0.25)
Executive's Age	N/A	N/A	0.040***	0.006***	N/A	N/A	0.040***	0.006***
			(6.79)	(6.85)			(6.81)	(6.88)
Gender	N/A	N/A	N/A	N/A	-0.153	-0.023	0.207	0.030
					(-0.51)	(-0.51)	(0.61)	(0.61)
Constant	1.641***	N/A	-0.624	N/A	1.796***	N/A	-0.846	N/A
	(5.54)		(-1.40)		(4.24)		(-1.47)	
Observations	4,254	4,254	3,901	3,901	4,254	4,254	3,901	3,901
Pearson Chi^2	0.412	N/A	0.486	N/A	0.488	N/A	N/A	N/A
Correctly Classified	0.812	N/A	0.817	N/A	0.817	N/A	N/A	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Robustness Checks for External Governance Using Different Overconfidence Measure

Table 8, panel I depicts the analysis of percentage shareholdings of number of blockholders for external corporate governance of firms headed by overconfident CEOs. As a robustness check of main analysis, we use Galasso and Simcoe (2011) with 100% in-the-money to measure CEO overconfidence. Confirming our past results, we find blockholders shareholdings and numbers are 2.69 and 2.0 percent lower in firm lead by overconfident CEOs. We research into further details into the structure outside and officer blockholders and conclude that while both are negatively associated, officer blockholders (1.77 percent) are comparative more unpopular than outside (1.63 percent) blockholders. CEO controls; CEO Duality and board size, also display negative association with blockholders, more significantly for officer block. For firm level variables, we find lower number and percentage shareholdings for larger firms, higher Cash, Tobin's Q and ROA.

Panel I: Regression Estimates for Blockholders for Overconfident CEOs Using Galasso and Simcoe (2011) With 100% in-the-money

The table presents the results of regression estimates of Percentage Shareholdings and Number of all, outside and officer Blockholders on CEO overconfidence. Percentage shareholdings by Blockholders represents the percentage of firm stock owned by all (column 1), outside (column 3) and officer (column 5) blockholder in that firm-year. Number of Blockholders represent number of all (column 2), outside (column 4) and officer (column 6) blockholder in that firm-year. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) Percentage held by all Blockholders	*(2) Number of all Blockholders*	*(3) Percentage held by outside Blockholders*	*(4) Number of outside Blockholders*	*(5) Percentage held by officer Blockholders*	*(6) Number of officer Blockholders*
OC_GS100	-2.686***	-0.220***	-1.634**	-0.157**	-1.765***	-0.097***
	(-3.63)	(-2.89)	(-2.33)	(-2.05)	(-5.63)	(-4.42)
CEO Duality	-0.300	-0.100	-0.016	-0.063	0.189	0.005

	(-0.32)	(-1.03)	(-0.02)	(-0.65)	(0.48)	(0.19)
Board Size	-0.316	-0.037	0.191	-0.005	-0.519***	-0.046***
	(-0.80)	(-0.92)	(0.51)	(-0.12)	(-3.10)	(-3.93)
Log(sale)	-6.462***	-0.620***	-3.625***	-0.433***	-2.209***	-0.170***
	(-13.98)	(-12.98)	(-8.27)	(-9.06)	(-11.28)	(-12.44)
Cash	-0.731	-0.085*	-0.397	-0.063	0.309	0.040***
	(-1.53)	(-1.72)	(-0.87)	(-1.28)	(1.52)	(2.86)
BHAR	-0.104	-0.011	0.040	0.006	-0.095	-0.013
	(-0.32)	(-0.33)	(0.13)	(0.19)	(-0.69)	(-1.39)
Tobin's Q	-2.374***	-0.247***	-1.909***	-0.217***	-0.241	-0.013
	(-5.55)	(-5.58)	(-4.70)	(-4.91)	(-1.33)	(-1.02)
Sales growth	0.078	0.050	0.099	0.036	0.158	0.013
	(0.20)	(1.23)	(0.26)	(0.87)	(0.94)	(1.13)
ROA	-0.227	-0.091**	-1.083**	-0.144***	1.044***	0.076***
	(-0.51)	(-1.98)	(-2.56)	(-3.11)	(5.52)	(5.74)
Constant	28.088***	3.216***	23.863***	2.761***	2.859	0.210
	(3.56)	(3.95)	(3.19)	(3.38)	(0.85)	(0.90)
Observations	2,269	2,269	2,269	2,269	2,269	2,269
Adjusted R^2	0.343	0.317	0.247	0.260	0.329	0.358

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8, panel II depicts the analysis of percentage shareholdings of number of blockholders for external corporate governance of firms headed by overconfident CEOs. As a robustness check of main analysis, we use Malmendier and Tate (2005) with 67% in-the-money to measure CEO overconfidence. Confirming our past results, we find blockholders shareholdings and numbers are substantially lower in firm lead by overconfident CEOs. We research into further details into the structure outside and officer blockholders and conclude that while both are negatively associated, officer blockholders (2.08 percent) are comparative more unpopular than outside (1.24 percent) blockholders. CEO controls: CEO Duality and board size, also display negative association with blockholders, more significantly for officer block. For firm level variables, we find lower number and percentage shareholdings for larger firms, higher Cash, Tobin's Q and ROA.

Panel II: Regression Estimates for Blockholders for Overconfident CEOs Using Malmendier and Tate (2005) With 67% in-the-money

The table presents the results of regression estimates of Percentage Shareholdings and Number of all, outside and officer Blockholders on CEO overconfidence. Percentage shareholdings by Blockholders represents the percentage of firm stock owned by all (column 1), outside (column 3) and officer (column 5) blockholder in that firm-year. Number of Blockholders represent number of all (column 2), outside (column 4) and officer (column 6) blockholder in that firm-year. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) Percentage held by all Blockholders	*(2) Number of all Blockholders*	*(3) Percentage held by outside Blockholders*	*(4) Number of outside Blockholders*	*(5) Percentage held by officer Blockholders*	*(6) Number of officer Blockholders*
OC_MT67	-3.362***	-0.251***	-1.238*	-0.125*	-2.082***	-0.118***
	(-4.95)	(-3.57)	(-1.92)	(-1.78)	(-7.24)	(-5.89)
CEO Duality	-0.122	-0.090	-0.052	-0.065	0.284	0.011
	(-0.13)	(-0.92)	(-0.06)	(-0.67)	(0.72)	(0.41)
Board Size	-0.412	-0.044	0.170	-0.007	-0.576***	-0.049***
	(-1.04)	(-1.08)	(0.45)	(-0.18)	(-3.45)	(-4.22)
Log(sale)	-6.336***	-0.611***	-3.591***	-0.429***	-2.133***	-0.165***
	(-13.72)	(-12.78)	(-8.17)	(-8.96)	(-10.92)	(-12.14)
Cash	-0.781	-0.089*	-0.424	-0.066	0.276	0.039***
	(-1.64)	(-1.80)	(-0.93)	(-1.33)	(1.37)	(2.74)
BHAR	-0.092	-0.010	0.042	0.007	-0.088	-0.013
	(-0.29)	(-0.31)	(0.14)	(0.20)	(-0.64)	(-1.35)
Tobin's Q	-2.283***	-0.242***	-1.936***	-0.219***	-0.194	-0.010
	(-5.35)	(-5.47)	(-4.77)	(-4.95)	(-1.07)	(-0.79)
Sales growth	0.086	0.051	0.087	0.035	0.161	0.013
	(0.22)	(1.24)	(0.23)	(0.84)	(0.96)	(1.16)
ROA	-0.250	-0.094**	-1.114***	-0.146***	1.026***	0.075***
	(-0.56)	(-2.04)	(-2.64)	(-3.18)	(5.46)	(5.70)

Constant	29.229***	3.281***	23.644***	2.747***	3.464	0.248
	(3.71)	(4.03)	(3.16)	(3.36)	(1.04)	(1.07)
Observations	2269	2269	2269	2269	2269	2269
Adjusted R^2	0.347	0.319	0.247	0.259	0.336	0.363

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8, panel III depicts the analysis of percentage shareholdings of number of blockholders for external corporate governance of firms headed by overconfident CEOs. As a robustness check of main analysis, we use Malmendier and Tate (2005) with 100% in-the-money to measure CEO overconfidence. Confirming our past results, we find blockholders shareholdings and numbers are substantially lower in firm lead by overconfident CEOs. We research into further details into the structure outside and officer blockholders and conclude that while both are negatively associated, officer blockholders (1.47 percent) are comparative more unpopular than outside (1.03 percent) blockholders. CEO controls; CEO Duality and board size, also display negative association with blockholders, more significantly for officer block. For firm level variables, we find lower number and percentage shareholdings for larger firms, higher Cash, Tobin's Q and ROA.

Panel III: Regression Estimates for Blockholders for Overconfident CEOs Using Malmendier and Tate (2005) With 100% in-the-money

The table presents the results of regression estimates of Percentage Shareholdings and Number of all, outside and officer Blockholders on CEO overconfidence. Percentage shareholdings by Blockholders represents the percentage of firm stock owned by all (column 1), outside (column 3) and officer (column 5) blockholder in that firm-year. Number of Blockholders represent number of all (column 2), outside (column 4) and officer (column 6) blockholder in that firm-year. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) Percentage held by all Blockholders	*(2) Number of all Blockholders*	*(3) Percentage held by outside Blockholders*	*(4) Number of outside Blockholders*	*(5) Percentage held by officer Blockholders*	*(6) Number of officer Blockholders*
OC_MT100	-1.918**	-0.145*	-1.026	-0.095	-1.470***	-0.076***

	(-2.57)	(-1.88)	(-1.45)	(-1.23)	(-4.64)	(-3.46)
CEO Duality	-0.427	-0.112	-0.115	-0.073	0.139	0.002
	(-0.45)	(-1.16)	(-0.13)	(-0.75)	(0.35)	(0.07)
Board Size	-0.301	-0.036	0.203	-0.004	-0.514***	-0.045***
	(-0.76)	(-0.88)	(0.54)	(-0.09)	(-3.07)	(-3.89)
Log(sale)	-6.487***	-0.622***	-3.642***	-0.435***	-2.223***	-0.171***
	(-14.02)	(-13.02)	(-8.31)	(-9.09)	(-11.33)	(-12.48)
Cash	-0.759	-0.087*	-0.414	-0.065	0.291	0.039***
	(-1.58)	(-1.77)	(-0.91)	(-1.32)	(1.43)	(2.79)
BHAR	-0.119	-0.012	0.032	0.006	-0.105	-0.014
	(-0.37)	(-0.37)	(0.10)	(0.17)	(-0.76)	(-1.44)
Tobin's Q	-2.419***	-0.252***	-1.951***	-0.222***	-0.248	-0.014
	(-5.62)	(-5.66)	(-4.78)	(-4.98)	(-1.36)	(-1.08)
Sales growth	0.051	0.048	0.080	0.034	0.144	0.012
	(0.13)	(1.17)	(0.21)	(0.82)	(0.85)	(1.06)
ROA	-0.266	-0.095**	-1.111***	-0.146***	1.024***	0.074***
	(-0.59)	(-2.06)	(-2.62)	(-3.17)	(5.41)	(5.64)
Constant	27.311***	3.140***	23.251***	2.699***	2.554	0.189
	(3.46)	(3.85)	(3.10)	(3.31)	(0.76)	(0.81)
Observations	2,269	2,269	2,269	2,269	2,269	2,269
Adjusted R^2	0.341	0.316	0.246	0.259	0.326	0.356

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8, panel IV depicts the analysis of change of auditor from Big 4 to non-Big 4 for external corporate governance of firms headed by overconfident CEOs. As a robustness check of main analysis, we use three different measures of CEO overconfidence. Validating our results, we find overconfident CEOs are 4.7, percent, 5.6 percent and 4.6 percent more likely to change auditors from big 4 to non-Big 4 firms after they start out office. For CEO Duality we find more change of auditor, however board size shows less change of auditor from Big 4. Firm level variables show us higher change with larger, more cash positive, high Tobin's Q and ROA.

Panel IV: Regression Estimates and Marginal Effects for Change from Big 4 Auditor for Overconfident CEOs Using Galasso and Simcoe (2011) With 100% in-the-money, Malmendier and Tate (2005) With 67% in-the-money and Malmendier and Tate (2005) With 100% in-the-money

The table presents the results of regression estimates (column i) and marginal effects (column ii) of Change of auditors on CEO overconfidence. Change of Auditor is an indicator variable takes the value 1 if the firm had change of auditor from Big 4 to non-Big 4 accounting firms after the CEO took office and 0 otherwise. We use three different measures of CEO overconfidence:

i) OC_GS100: A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure (Galasso and Simcoe, 2011).

ii) OC_MT67: A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure (Malmendier and Tate, 2005).

iii) OC_MT100: A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure (Malmendier and Tate, 2005). Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) Big 4	*(1ii) Marginal Effects*	*(2i) Big 4*	*(2ii) Marginal Effects*	*(3i) Big 4*	*(3ii) Marginal Effects*
OC_GS100	0.198*	0.047*	N/A	N/A	N/A	N/A
	(1.93)	(1.94)	N/A	N/A	N/A	N/A
OC_MT67	N/A	N/A	0.237**	0.056**	N/A	N/A
			(2.35)	(2.37)		
					0.195*	0.046*
OC_MT100	N/A	N/A	N/A	N/A	(1.90)	(1.90)
CEO Duality	0.042	0.010	0.031	0.007	0.043	0.010
	(0.31)	(0.31)	(0.23)	(0.23)	(0.32)	(0.32)
Board Size	-0.081	-0.019	-0.076	-0.018	-0.081	-0.019
	(-1.38)	(-1.38)	(-1.29)	(-1.29)	(-1.38)	(-1.38)

Log(sale)	0.073	0.017	0.073	0.017	0.073	0.017
	(1.28)	(1.28)	(1.27)	(1.27)	(1.28)	(1.28)
Cash	0.170***	0.040***	0.173***	0.041***	0.171***	0.040***
	(3.30)	(3.34)	(3.35)	(3.39)	(3.32)	(3.36)
BHAR	-0.023	-0.005	-0.025	-0.006	-0.022	-0.005
	(-0.54)	(-0.54)	(-0.60)	(-0.60)	(-0.53)	(-0.53)
Tobin's Q	0.014	0.003	0.012	0.003	0.014	0.003
	(0.33)	(0.33)	(0.28)	(0.28)	(0.34)	(0.34)
Sales growth	0.110**	0.026**	0.109**	0.026**	0.110**	0.026**
	(2.33)	(2.35)	(2.32)	(2.33)	(2.34)	(2.36)
ROA	0.071	0.017	0.070	0.016	0.071	0.017
	(1.47)	(1.47)	(1.44)	(1.45)	(1.47)	(1.47)
Constant	-0.151	N/A	-0.201	N/A	-0.147	N/A
	(-0.45)		(-0.59)		(-0.44)	
Observations	1,864	1,864	1,864	1,864	1,864	1,864
Pearson Chi^2	0.338	N/A	0.340	N/A	0.337	N/A
Correctly Classified	0.607	N/A	0.607	N/A	0.606	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8, panel V depicts the analysis of change of auditor from Big 5 to non-Big 5 for external corporate governance of firms headed by overconfident CEOs. As a robustness check of main analysis, we use three different measures of CEO overconfidence. Validating our results, we find overconfident CEOs are 4.7, percent, 3.4 percent and 44.2 percent more likely to change auditors from big 5 to non-Big 5 firms after they start out office. CEO Duality shows insignificant influence for change of auditor; however, board size shows significant less change of auditor from Big 5. Firm level variables show us higher change with high cash positive, sales growth and ROA; but lower change for higher BHAR.

Panel V: Regression estimates and Marginal Effects for Change from Big 5 Auditor for Overconfident CEOs Using Galasso and Simcoe (2011) With 100% in-the-money, Malmendier and Tate (2005) With 67% in-the-money and Malmendier and Tate (2005) with 100% in-the-money

The table presents the results of regression estimates (column i) and marginal effects (column ii) of Change of auditors on CEO overconfidence. Change of Auditor is an indicator variable takes the value 1 if the firm had change of auditor from Big 5 to non-Big 5 accounting firms after the CEO took office and 0 otherwise. We use three different measures of CEO overconfidence:

i) OC_GS100: A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure (Galasso and Simcoe, 2011).

ii) OC_MT67: A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure (Malmendier and Tate, 2005).

iii) OC_MT100: A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure (Malmendier and Tate, 2005). Variable definitions are provided in the Appendix II (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) Big 5	*(1ii) Marginal Effects*	*(2i) Big 5*	*(2ii) Marginal Effects*	*(3i) Big 5*	*(3ii) Marginal Effects*
OC_GS100	0.194*	0.047*	N/A	N/A	N/A	N/A
	(1.90)	(1.91)	N/A	N/A	N/A	N/A
OC_MT67	N/A	N/A	0.142	0.034	N/A	N/A
			(1.43)	(1.43)		
					0.173*	0.042*
OC_MT100	N/A	N/A	N/A	N/A	(1.69)	(1.69)
CEO Duality	-0.064	-0.016	-0.058	-0.014	-0.060	-0.015
	(-0.48)	(-0.48)	(-0.43)	(-0.43)	(-0.45)	(-0.45)
Board Size	-0.106*	-0.026*	-0.107*	-0.026*	-0.107*	-0.026*
	(-1.84)	(-1.84)	(-1.84)	(-1.85)	(-1.86)	(-1.86)

Log(sale)	-0.023	-0.006	-0.022	-0.005	-0.023	-0.005
	(-0.41)	(-0.41)	(-0.39)	(-0.39)	(-0.40)	(-0.40)
Cash	0.211***	0.051***	0.214***	0.051***	0.212***	0.051***
	(3.99)	(4.05)	(4.05)	(4.12)	(4.01)	(4.08)
BHAR	-0.105**	-0.025**	-0.107**	-0.026**	-0.105**	-0.025**
	(-2.49)	(-2.51)	(-2.53)	(-2.55)	(-2.49)	(-2.50)
Tobin's Q	0.020	0.005	0.024	0.006	0.021	0.005
	(0.45)	(0.46)	(0.57)	(0.57)	(0.49)	(0.49)
Sales growth	0.156***	0.038***	0.158***	0.038***	0.157***	0.038***
	(3.31)	(3.35)	(3.34)	(3.38)	(3.33)	(3.37)
ROA	0.088*	0.021*	0.089*	0.021*	0.088*	0.021*
	(1.83)	(1.84)	(1.86)	(1.87)	(1.84)	(1.85)
Constant	0.461	N/A	0.467	N/A	0.473	N/A
	(1.39)		(1.40)		(1.43)	
Observations	1,864	1,864	1,864	1,864	1,864	1,864
Pearson Chi^2	0.341	N/A	0.348	N/A	0.340	N/A
Correctly Classified	0.657	N/A	0.605	N/A	0.613	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Paper 3

CEO Overconfidence and Corporate Employment Decisions

Abstract: Using a behavioural approach, we investigate how CEO overconfidence, defined as a personality trait where a person has optimistic predictions about the outcome of future events, influences employees hiring-firing decisions. Using data of publicly traded firms in the U.S. from 1993 to 2017, we show that firms with overconfident CEOs have higher employment growth rates and exhibit less pronounced employment sensitivity to declining sales or below industry-peer performance than firms with non-overconfident CEOs do. Using Kaplan Zingales index and total asset, we also find that the impact of overconfident CEOs on employment decisions is more prominent in financially constrained firms.

JEL classification codes: C21; J63; J68

Keywords: Overconfidence; hiring and firing decisions, industry fluctuations

1. Introduction

Researchers have emphasized the significance of corporate hiring preference, particularly firms' optimum investment in people (Pinnuck and Lillis, 2007; Falato and Liang, 2016; Ellul et al., 2018). These decisions are strategically important, not least because labour is an input of the production and such decisions often involve substantial costs on hiring, training, or severance (Blatter et al., 2012). Firms balance their workforce in accordance with operations and profitability (Williamson, 1963; Stein, 1989). Most of Untied States labor protection laws are based on minimum wage rather than employee protection (e.g., The Fair Labor Standards Act of 1938). Unionization may have played a role in defending workers' rights, but it has been nearly wiped out in the United States. Companies are not required by law to employ a certain number of employees. Their employment investment is based on asset and continuing expansion. (Roberts and Sufi, 2009). As a result, when the economy is doing well, most businesses expand their capacity and hire additional workers. Similarly, during a contraction, a company reduces its operations and eliminates employees. As a result, firm work force may be regarded the most defenceless case, and we are interested in seeing how it changes with the business cycle.

Building on the upper echelon theory (Hambrick & Mason, 1984) that illustrates the link between CEOs' characteristics, personalities and, indeed, cognitive biases and corporate policies (see e.g., Malmendier & Tate, 2005; Hirshleifer et al., 2012; Liu et al., 2020), we examine if CEOs' optimistic belief could influence their choices relating to HRM policies and practices. Our work is related to a nascent body of literature that examines factors that could explain CEOs' decisions relating to HRM policies. Wang et al. (2016) note that the link between CEO characteristics and firm strategic actions has practical significance for HR practitioners. Our novel behavioural-based evidence directly answers to the call for more research to examine the role of internal corporate governance and in particular of CEOs in shaping HRM system and their effect on an organisation's people (Mullins, 2018; Wood & Budhwar, 2021).

We propose that systematic overinvestment by overconfident CEOs (as documented in Malmendier & Tate, 2005 among others) might be associated with higher investment in both physical and human capital, which leads to more hiring

compared with non-overconfident CEOs and that overconfident CEOs might also have very different views regarding hiring and firing in response to fluctuations in firm performance. Specifically, overconfident CEOs may attribute the good times, e.g. when firms experience positive sales growth, to their ability to predict and achieve such outcomes, and consequently hire more. In the bad times, e.g. when sales decline, layoffs can be seen as a valid strategic response by shareholders to improve firm performance (Ataullah et al., forthcoming). Optimistic CEOs, however, might be reluctant to contract the operation and fire workers as they believe in their ability to improve firm performance. This behavior would be in line with evidence from the psychology literature in which optimistic individuals believe that they are more able and have better prospects than their peers (Svenson, 1981; Alicke et al., 1995) and that good outcomes are due to their ability (Gilovich et al., 2002; Wang et al., 2016).

Existing literature shows that HRM policies and practices are affected by many factors, such as organisation culture imprinting (Kidwell et al., 2018), top management team (Järlström et al., 2018), and relationship with suppliers and customers (Lengnick-Hall et al., 2013). The HRM literature has addressed the strategic and broad role of CEOs, and to some extent top management, in adopting certain HRM policies such as providing supports and shaping culture and priorities (McCullugh & Sims, 2012; Woodrow & Guest, 2014). There is also evidence, albeit limited, on the CEOs and top management's roles in the implementation of HRM policies (Stirpe, et al., 2013; Kirton, et al., 2016) or how the same CEO implements HR policies in two different companies and how different CEOs implement HR policies in the same firm (Mirfakhar, et al., 2021). The evidence is context-specific, for example a civil service agency (McCullugh & Sims, 2012) or an NHS hospital (Woodrow & Guest, 2014).

Few recent studies, however, have shed light into what determine the CEOs' HRM decisions and choices. Frear et al., (2012) document that CEO background, specifically the exposure to Western-style ideology would influence firm adoption of Western-style HR practices in foreign-invested enterprises in China. McClean & Collins (2018) show that a combination of high-commitment human resource practices and CEO charismatic leadership could result in low voluntary employee turnover and high firm performance. Ng & Sears (2017) report that CEO gender could influence the gender-related recruitment practices. More specifically, the presence of a female CEO

when combined with active recruitment of women practice could enhance the promotion of women in the workplace. Ren et al., (2021) find evidence of the effect of the environmental belief of CEOs on green HRM, i.e. an HRM system with "the aim of achieving the strategic goals in the environmental domain" (p. 78). Horton et al., (forthcoming) show that a CEO's financial incentive stemmed from their membership of the firm's defined-benefit pension plan plays a key role on pension-provision decisions.

We choose to investigate how CEO overconfidence affects company employment, especially fixed labor investment. We use the number of employees as a labor investing alternative for a variety of reasons. First, investment in employees is a substantial flat cost. The law of diminishing returns suggests this will be one of the first factors of production to be subject of inefficiencies. Therefore, this is likely to be one of the first investments to be cut down. Second, comparative to capital expenditure, investments in employees are liquid and reversible (Pindyck, 1988). This allows us to examine the impact of business fluctuations, as on the next analysis we consider industry expansion-contraction as a control variable. Third, divestment/addition of firm business will be quickly reflected by a reduction/addition of employees. Finally, the use of employees is appealing because its reporting is fundamental to all firms and detailed non-missing data is available. This gives us the flexibility to test our hypothesis on a broad cross-section of firms. For our main analysis, we follow the labor demand model of Pinnuck and Lillis (2007) to estimate a firm's expected level of net hiring. Their model specification is similar to those used in recent studies (Chodorow-Reich, 2014; Falato and Liang, 2016; Giroud and Mueller, 2017; Ellul et al., 2018; Benmelech et al., 2019) but in addition it uses a more comprehensive list of firm-level variables to explain normal hiring practices. In our robustness checks, we consider several modifications to this model, for instance, we use eleven different measures to indicate labor hiring and change the intensity of how we measure CEO overconfidence. In addition, we estimate expected net hiring at a level regression and validate the results. Our findings are robust to the use of all alternatives.

2. Literature Review

Literature leads to ambiguous conclusion about the economic performance of downscaling firms. Worrell, David and Sharma (1991) used event-study methods and conclude different results based on reason of downsizing. With 90-days window, significant negative market reaction was observed with cumulative loss of 2 percent in stock value of the firms. For 180-days window, 3.6 percent increase in stock value was seen for firms that provided restructuring and merging as the reason for the layoffs. And for firms that stated financial hardship as a reason for the layoffs, share prices declined an average of 5.6 percent over the test period. As stressed by Narayanan (1985), Stein (1989), Froot et al. (1992), Porter (1992) and Von Thadden (1995), outside investors' biased demands can lead management to reject down lucrative investment possibilities owing to concern for the firm's short-term stock price. A manager interested in short-term outcomes might, therefore, underinvest in labor for fear that these investments would lower income and negatively influence equity prices (Porter, 1992; Bushee, 1998). Empirical evidence by Graham et al. (2005) reports that a significant number of managers are willing to give up projects that will be profitable in the long run to meet short-run earnings targets. They discover that businesses might postpone or cancel employment to meet short term profit objectives.

Discrepancy from optimum labor investment is costly from either end, as in the case of over-investment it may lead to over-capacity problems and lower productivity, or insufficient growth in the case of under-investment (Williamson, 1963; Stein, 1989). These problems are more in contemporary firms since they are more human-capital intensive (Pfeffer, 1996; Zingales, 2000). Circumstantial evidence suggests that shareholders, and particularly institutional investors, welcome the labor investments. For example, an alliance of institutional investors with over $2.8 trillion under management recently petitioned the Securities and Exchange Commission (SEC) to introduce rules requiring firms to increase disclosure on their human capital management policies. Also, BlackRock publishes an annual report detailing its approach to engagement on human capital management, which lists voluntary and involuntary turnover as well as employee tenure when engaging with the management teams of firms in its portfolio.

Employment growth can take place when egocentric managers risk internal disputes and hire individuals as part of their empire building objectives. Williamson (1963) uses the expansion of staff numbers beyond optimum levels as an example of managers' opportunistic behavior aimed at obtaining more security and power. Bertrand and Mullainathan (2003) show that managers may be hesitant to trim an inefficient workforce because of their preference for the quiet life and desire to avoid the difficult decisions and costly effort associated with downsizing. Pagano and Volpin (2005) demonstrate that top managers facing potential sacking for poor performance may form coalition with the workforce by refraining from worker layoffs and wage cuts. Workers, in return, may help keep such managers if they have sufficient power to affect such decisions. Similarly, Atanassov and Kim (2009) show that weak investor protection combined with strong union laws leads to worker-management alliances, in which poorly performing firms sell assets to prevent large-scale layoffs, garnering worker support for retaining the management. Landier et al. (2009) find that firms in the U.S. are less likely to lay off workers who are located geographically closer to the corporate headquarters, and that this behavior may, in part, reflect private benefits to CEOs that come from interacting with workers and communities close to the corporate headquarters.

Downsizing employees does not promote a healthy business environment. The cost-cutting benefits of the downscaling strategy could potentially be offset by Survivors' Syndrome (Brockner, 1988). Existing personnel may not be confident and comfortable in working for a company which layoffs staff amid economic mayhem. An underlying assumption for employee cut-offs would be firm’s executives seeking to operate with minimum costs and that they choose to economize by decreasing their workers. This shows that management believes that the expansion of companies has paused in recent times and that they can recruit in future if necessary. This demonstrates a lack of trust in the company's prospects. Hambrick and Mason (1984) argue that strategic decisions reflect the ideas and intellectual focus of senior managers. They propose “upper-echelons” theory which stipulates that management bias can anticipate organizational decisions. In this instance, we believe CEO overconfidence plays a role in firms’ response to employment during business cycles. We predict rational manager will hire employees during expansion and reduce employee during economic

contraction. However, overconfident CEO always have responded differently than others. They are optimistic by nature and have broken traditional norms of corporate strategies. This is why a vast stream of literature documents how firm headed by overconfident CEOs handle their business operation. Literature document that CEO overconfidence influences dividend policy (Deshmukh et al., 2013), investments strategies (Hackbarth, 2009), mergers and acquisitions (Malmendier and Tate, 2008), financial risk (Malmendier and Nagel, 2011), and corporate governance (Kim and Lu, 2011; Van den Steen 2004). However, due to the variations in adjustment costs, the current inferences cannot be used in analysing employment investments. In this article, we discuss the employment fluctuation of US publicly traded companies. This gap is analysed by controlling for CEO overconfidence to determine the influence with other vital factors of company employment.

There is a significant number of literatures which analyses the association of CEO overconfidence with corporate decisions such as merger and acquisitions, cash flow volatility and overinvestment. Malmendier and Tate (2008) finds CEO overconfidence to clarify the merger and acquisition (M&A) decisions, while Billett and Qian (2008) documents its association with more M&A frequencies. Overconfident CEOs tend to overestimate the discounted future cash flow from risky decisions. They are deluded by the control of results and predict illusory good results. Furthermore, overconfident CEOs are more optimistic about their upbeat performance from hard task rather than easy one (Griffin and Tversky, 1992). From this strand, we expect overconfident CEOs to increase workforce comparatively more during economic expansion compared to rational CEOs. They overstate their capacity to capitalize on development due to their optimistic nature, and so should employ more. On the other hand, during contraction, we expect overconfident CEOs to set off fewer employees because they believe they can turn around the situation fast and consequently maintains the workforce.

Our research relates to a growing body of literature on the interactions between labor and corporate policies in the presence of governance mechanisms. Literatures have reviewed managers' downsizing decisions (Bertrand and Mullainathan, 2003; Perry and Shivdasani, 2005), their incentives to plan with workers for mutual protection (Pagano and Volpin, 2005; Atanassov and Kim, 2009), their preference for maintaining

strong ties with employees, increasing worker wages, and avoiding lay-offs (Cronqvist et al., 2009; Landier et al., 2009), as well as their motivations to under-invest in labor (Graham et al., 2005). Our paper can be related to three current studies by Jung et al. (2014), Ben-Nasr and Alshwer (2016), and Khedmati et al. (2019) who investigates the implications of agency conflicts for labor investments. However, the aim of those studies is different from ours, as they examine financial reporting quality, stock price informativeness, and absence of CEO-director ties. We, on the other hand, show that under various retention and firing measures, overconfident CEOs are inclined towards firing less employees and also have a positive employment growth over the years.

3. Hypothesis Development

Guided by the literature, we investigated four hypotheses in this study. The first two hypothesis discusses the over-optimistic nature of overconfident CEOs regarding HR policies, and we predict them to invest more in firm labor. We expect that, in given circumstances, an overconfident CEOs will appoint more employees and lay off less employees compared to their peers.

H_1: Overconfident CEOs are more likely to have larger increase in employment.

H_2: Overconfident CEOs are more likely to have smaller decrease in employment.

Conventionally, labor is considered a variable factor of production which can be paid out from firm revenues and has limited alteration costs (Dixit and Pindyck, 1994). Compared to capital expenditures, the timing of labor investments well matches with that of current-year revenues, and labor costs can be covered by operating cash flows (Jung et al., 2014; Khedmati et al., 2019). Labor cost has limited market conflicts and can be adjusted at a very low cost (Bloom, 2009). And when firms diverge from optimal net hiring, they can effortlessly slip back to the optimal level. In the absence of market frictions, labor investment gets little, if any, monitoring by investors. Combining this argument, the question of whether CEO overconfidence play a role in

shaping firms' employment decisions during industry expansion/contraction, could answer some of the questions. This starts our third and fourth hypotheses:

H_3: Overconfident CEOs are more likely to have larger increase in employment during industry expansion

H_4: Overconfident CEOs are more likely to have smaller decrease in employment during industry contraction

4. Research Methodology

4.1. Data and Sample

Our study is based on CEOs of US listed firms from 1993-2017. We exclude missing information on variable used to calculate CEO overconfidence measure and all control variables needed for the base specifications. Following previous studies, all financial and utilities firms have been excluded. The data on managerial compensation are collected from Standard and Poor's Execucomp, financial and accounting variables from Compustat and stock returns from the Center for Research in Security Prices (CRSP) database. All financial and accounting variables are winsorised at 1 percent and 99 percent to eliminate the effects of outliers. The final sample consists of 4,812 CEOs, 3,859 firms and 23,663 firm-year observations between 1995-2017.

4.2. Research Model

Various methods for estimating firm's net hiring are documented in prior economics, accounting, and finance literature. In labor economics literature, for instance, Hamermesh (1989) originates a simple model of long-run equilibrium labor demand, which maximizes firm value. Other studies use labor demand forecasting model by controlling for firm level characteristics. We follow the second thread of research and use the labor forecasting model of Pinnuck and Lillis (2007), which is similar to the employment models estimated in recent studies by Chodorow-Reich,

2014; Falato and Liang, 2016; Giroud and Mueller, 2017; Ellul et al., 2018. However, while the above studies only include a narrow number of explanatory variables, the Pinnuck and Lillis (2007) model uses an extensive list of firm-specific variables to explain firms net hiring practices. We follow their approach and use the following model to conduct our analysis:

$$y_{i,t} = \alpha_1 + \alpha_2 OC_{i,t-1} + \beta' X_{i,t-1} + \nu_i + \mu_t + \varepsilon_{i,t} \quad \text{.....(i)}$$

where $y_{i,t}$ is firm *i*'s absolute net hiring or the dummy net hiring dependent variables in year *t*, $OC_{i,t-1}$ is a dummy variable that takes a value of 1 if firm *i* has an overconfident CEO in year *t-1*, and 0 otherwise, $X_{i,t-1}$ is a vector of characteristics of firm *i* in year *t-1*, ν_i and μ_t are year and industry fixed effects, respectively, and $\varepsilon_{i,t}$ is the random error.

4.3. Construction of Dependent Variables

Annual growth rate in firm employment is our main dependant variable. Following Pinnuck and Lillis (2007), Ellul et al. (2018), and Benmelech et al. (2019), we use firms net hiring, measured as the percentage change in the number of employees between year t-1 and year t. This variable is the substitute for investment in firms' employment. Compustat lists firm's number of employees in thousands by year. To account for different industry and firm size, we take employee growth rate as dependent variable. To account for employment growth or downsizing, we use eleven dependent variables:

- Dependent Variable 1: **Net_Hiring**: measured as the percentage change in the number of employees between year t-1 and year t, measured as $(emp_t - emp_{t-1})/ emp_{t-1}$

- Dependent Variable 2: **Emp_Growth_01**: indicator variable takes a value of 1 if $(emp_t - emp_{t-1})/ emp_{t-1} > 1.0$ percent. This variable accounts for over investment in labor when employment growth rate is above 1.0 percent. We regressed it against CEO overconfidence to analyse the association of both.

- Dependent Variable 3: **Emp_Growth_05**: indicator variable takes a value of 1 if $(emp_t - emp_{t-1})/ emp_{t-1} > 5.0$ percent. This variable accounts for over investment in labor when employment growth rate is above 5.0 percent. We regressed it against CEO overconfidence to analyse the association of both.

Dependent Variable 4: **Emp_Growth_10**: indicator variable takes a value of 1 if $(emp_t - emp_{t-1})/ emp_{t-1} > 10.0$ percent. This variable accounts for over investment in labor when employment growth rate is above 10.0 percent. We regressed it against CEO overconfidence to analyse the association of both.

- Dependent Variable 5: **Emp_Growth_15**: indicator variable takes a value of 1 if $(emp_t - emp_{t-1})/ emp_{t-1} > 15.0$ percent. This variable accounts for over investment in labor when employment growth rate is above 15.0 percent. We regressed it against CEO overconfidence to analyse the association of both.

Dependent Variable 6: **Emp_Growth_20**: indicator variable takes a value of 1 if $(emp_t - emp_{t-1})/ emp_{t-1} > 20.0$ percent. This variable is a stronger measure for over-investment in firm employment. We take employee growth rate of 20.0 percent or more to quantify the extent of involvement of overconfident CEOs in labor expansion.

- Dependent Variable 7: **Emp_Reduction_01**: indicator variable takes a value of 1 if $(emp_t - emp_{t-1})/ emp_{t-1} < -1.0$ percent. This dummy variable measures firm under investment in labor. If firms' employment growth is less than minus1.0 percent, then the dummy takes value 1 and we regress it on overconfident CEOs to observe their influence on firm labor.

- Dependent Variable 8: **Emp_Reduction_05**: indicator variable takes a value of 1 if $(emp_t - emp_{t-1})/ emp_{t-1} < -5.0$ percent. Here we take a more tough way to address under investment in firm labor by assigning the value 1 if labor growth is less than minus 5.0 percent.

- Dependent Variable 9: **Emp_Reduction_10**: indicator variable takes a value of 1 if $(emp_t - emp_{t-1})/ emp_{t-1} < -10.0$ percent. This dummy variable measures firm under investment in labor. If firms' employment growth is less than minus10.0 percent,

then the dummy takes value 1 and we regress it on overconfident CEOs to observe their influence on firm labor.

-Dependent Variable 10: **Emp_Reduction_15**: indicator variable takes a value of 1 if $(emp_t - emp_{t-1})/ emp_{t-1} < -15.0$ percent. This dummy variable measures firm under investment in labor. If firms' employment growth is less than minus15.0 percent, then the dummy takes value 1 and we regress it on overconfident CEOs to observe their influence on firm labor.

- Dependent Variable 11: **Emp_Reduction_20**: indicator variable takes a value of 1 if $(emp_t - emp_{t-1})/ emp_{t-1} < -20.0$ percent. This dummy variable measures firm under investment in labor. This is the most conservative way to measure employment downsizing. If firms' employment growth is less than minus20.0 percent, then the dummy takes value 1 and we regress it on overconfident CEOs to observe their influence on firm labor.

4.4. Construction of Independent Variable: CEO Overconfidence

CEO overconfidence is the main independent variable of this study. Researchers previously have used CEOs stock option holding to measure overconfidence. For instance, Malmendier and Tate (2005a, 2008) use 67 percent in-the-money option and 5 years of remaining duration and marked non-exercise as overconfidence. Glasso and Simmcoe (2011) use 67 percent in-the-money options and labelled CEOs as overconfident when they do not exercise those options. For this paper, we measured overconfidence as Glasso and Simmcoe (2011) at 67 percent and 100 percent in-the-money; and Malmendier and Tate (2005a, 2008) at 67 percent in-the-money stock options. An overconfident CEO takes the value 1 if s/he postpones the exercise of 67 percent or 100 percent in-the-money stock options, and 0 otherwise. Using this technique, if CEO displays overconfidence at least twice, the individual is considered as overconfident for his entire tenure (Glasso and Simmcoe, 2011) or from the first time they display overconfidence (Malmendier and Tate, 2005a, 2008). Not exercising an in-the-money option after vesting period means the CEO is confident that stock price will further rise in future, and s/he wants to capitalize the profit opportunity. As detailed

data on CEOs stock option holding and exercise price is not available, we follow Campbell et al. (2011) for calculating the average moneyness of the executive's option portfolio. For each CEO-year, the average realizable value per option is calculated by dividing total realizable value of the options by the number of options held by him. The strike price is calculated as the fiscal year-end stock price minus the average realizable value. The average moneyness of the options is then calculated by dividing average realisable value by strike price. Hirshleifer et al. (2012) also computed CEO overconfidence using this method. We only include the unexercised exercisable options held by the CEO.

$$\boldsymbol{Average\ realizable\ value\ per\ option} = \frac{\boldsymbol{Total\ realizable\ value\ of\ the\ options}}{\boldsymbol{Number\ of\ options\ held}}$$

$$\boldsymbol{Strike\ price} = \boldsymbol{Stock\ price} - \boldsymbol{Average\ realizable\ value}$$

$$\boldsymbol{Average\ moneyness} = \frac{\boldsymbol{Average\ realisable\ value}}{\boldsymbol{Strike\ price}}$$

4.5. Construction of Control Variables

As our main test specifications examine the relationship between changes in employment and overconfident CEO, our control variables include several lagged changes in other firm level characteristics. This has two implications. First, the use of levels lowers the power of the research to obtain information as to what drives inter-firm investment differences additional to firm-specific effects. Second, the residuals in the level regressions might be serially correlated. For this reason, we use lags of our control variables for the analysis. Our first control variable, Sales Growth is calculated by dividing the current year sales by the prior year's sales and subtracting 1. This represents change in demand for the firm's products and services and is considered to be the fundamental determinant of profitability and the level of investment a firm should make. We take changes in lag sales growth to accommodate the time required

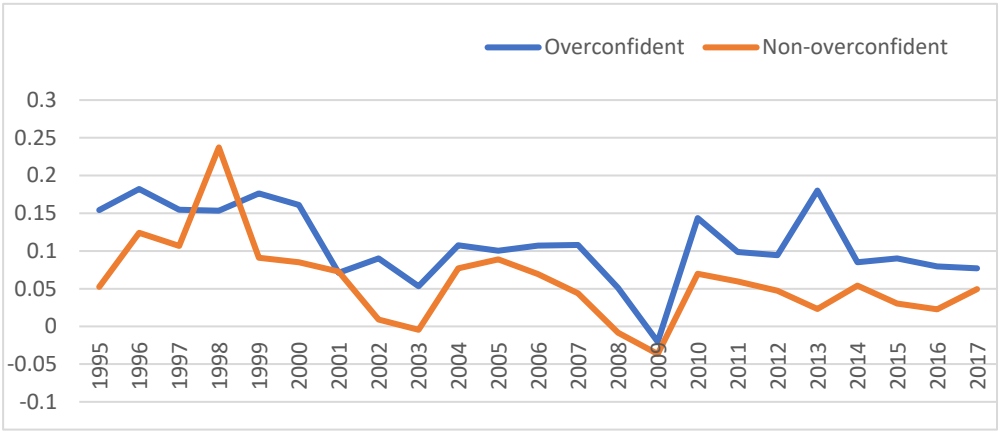
to adjust sales growth and change in firms' employees. Second, changes in profit represents the change in Net Income scaled by beginning-of-year total assets. This variable, in addition to Sales Growth, control the normal fundamental impact of a change in earnings on the demand for labor. Return volatility or RetVol is the volatility of weekly stock returns within a year. Profitability is a fundamental determinant of firms' capacity to invest in labor. Lag change in profitability is included because of the time lag between profitability and employee changes. Third, change in leverage is the change in ratio of long-term debt plus debt in current liabilities, scaled by beginning-of-yearbook value of assets. Change in leverage highlights long-term financing needs and points if reduced funds are available for investment, which may trigger delay in hiring or reduction of employees. Fourth, change in Quick Ratio represents change in the ratio of cash and short-term investments plus receivables to current liabilities. This depicts short term liquidity needs and indicates if changes in employment is due to cash flow shortages and short-term liquidity problems.

Other change variables include changes in Tobin's Q, where Tobin's Q is calculated as the market value of equity plus the book value of liabilities, all divided by the book value of assets, the change in capital expenditures or CapEx, where CapEx_Ratio is calculated as firm capital expenditures divided by the book value of assets. These controls are all lagged by one year in our tests. We also use one additional control variables related to employment: lagged Employment Growth, to control for recent trends that might affect the dependent variable. All variables definition is listed in the Appendix III (B).

5. Empirical Results

Figure 1 shows that overconfident CEOs have higher employment growth rate throughout the sample years. Here employment growth refers to net hiring which is the change in employees from last year.

Figure 1: Employment growth for Overconfident and non-overconfident CEOs



The descriptive statistics and univariate test in table 1 shows that net hiring for overconfident CEOs is much higher (almost 3 times more) than their non-overconfident counter parts. Similar findings are drawn by Ghaly et al., (2020), Jung et al. (2014) and Pinnuck and Lillis, (2007) who reports net hiring to be 5 percent, 7 percent and 5.4 percent respectively. Change in lagged employment growth for overconfident CEOs are higher as well at 9.80 percent. Other control variables; such as change in Sales growth, Stock returns, Profit, Leverage, Quick ratio, Capex and Tobin's Q are higher for overconfident CEOs.

[Table 1 from Appendix III (C) here]

Table 2 depicts the regression estimates and marginal effects for net hiring, employment growth and reduction dummies. The results confirm our hypothesis 1 that overconfident CEOs have higher net hiring (column 1) and employment growth (column 2i and 2ii); and also confirms hypothesis 2 that overconfident CEOs have lower employee firing (column 3i and 3ii). Column 1-2ii measures employment increase, while column 3i-3ii shows employment reduction. Column 1 measures net hiring rate, column 2i indicates a dummy 1 when employment growth is more than 1.0 percent and column 3i indicates a dummy 1 when employment downsizing is less than minus 1.0 percent. Overconfident CEOs display positive significant association with

both absolute and net hiring dummy, concluding our first hypothesis that overconfident CEOs have more employment increase than their peers. Overconfident CEOs have 3.4 percent more employment growth rate and are 10.6 percent more likely to have a 1.0 percent or more employment growth. This increase is accompanied by higher lagged employment growth, sales growth, stock return volatility, change in net profit, change in quick ratio, change in capital expenditure ratio, and change in Tobin's Q. As expected, the increased employment is followed by decrease in change in leverage.

Column 3i supports our second hypothesis that overconfidence in CEO have smaller decrease in employment. We measure employment decrease as a dummy which takes the value 1 if employment growth is at less than minus1.0 percent and 0 otherwise. Results shows overconfident CEOs are 9.5 percent less likely to have a negative 1.0 percent employment growth. This likelihood is followed by lower lagged employment growth, sales growth, stock return volatility, change in net profit, change in Quick ratio and change in Tobin's Q. It is on the other hand associated with higher change in leverage and higher capital expenditure.

[Table 2 from Appendix III (C) here]

To test our third and fourth hypothesis, we use lagged industry sales median, rolling lagged cash flow volatility, Kaplan Zingales and total asset as a measure of industry expansion or contraction. For first measure, we use industry sales median for last 3 years and mark dummy industry expansion as 1 if all three lagged medians are greater than zero. To analyse the impact of overconfident CEOs on firm employment during industry expansion, we interact CEO overconfidence with industry expansion and monitor the interaction coefficient to determine the influence. Column 1-2ii, where we measure employment growth, the interaction term of CEO overconfidence and industry expansion display significant positive coefficient. It concludes that during an industry expansion, overconfident CEOs have larger employment growth by 1.3 percent; and their probability increases by 2.6 percent for growth over 1.0 percent. The results confirm a positive correlation between economic growth and employment growth, as documented in Mankiw, (2012) and Ball et al., (2013). Next, we regress the

dependent variable, Emp_Reduction, which measures negative 1.0 percent employment growth. In column 3i-3ii, the interaction term between CEO overconfidence and industry expansion shows negative value. These results confirm our fourth hypothesis that during an industry expansion, an overconfident CEOs are 1.4 percent less likely to decrease employment, i.e., they have larger growth in employment than the peers.

As a robustness check to our third and fourth hypothesis, in table 4 we use rolling lagged cash flow volatility; a second measure to determine industry expansion/contraction. Cashflow volatility is calculated as the rolling standard deviation of last 4 years cashflow; which means it is the standard deviation of 5 years of cashflow in total, where cashflow is measured by Operating Income Before Depreciation scaled by net assets (total assets minus cash and marketable securities). The coefficient for CEO overconfidence shows positive, confirming our hypothesis that an overconfident CEO has more employment growth during industry contraction. For employment growth rate over 1.0 percent, overconfident CEOs are 4.9 percent more likely for an increase. Our hypothesis is as well, supported by another dependent variable, Emp_Reduction, which indicates unlikeliness of 2.6 percent for overconfident CEOs to decrease firm labor.

[Table 3 and Table 4 from Appendix III (C) here]

As a second robustness check to our third and fourth hypothesis, we divide the entire sample into three equal groups based on ascending order of Kaplan Zingales Index (Table 5: Panel I, II, III) and Total asset (Table 6: Panel I, II, III). Each firm is categorized based on their lagged Kaplan Zingales value and total asset. We then run individual analysis for each of three sub-samples to observe the coefficient of overconfident CEOs with respect to different measures of employment growth. The results, yet again supports our hypothesis that during expansion (proxied by lower Kaplan Zingales), overconfident CEOs have larger employment growth by 2.1 percent, 8.5 percent more likely to have greater than 1.0 percent employment growth and 7.6 percent less likely to have less than negative 1.0 employees downsizing. And during contraction (proxied by higher Kaplan Zingales, meaning they are more financially

constraint) they show further net hiring (4.7 percent) and as well as more likelihood (12.1 percent) of employment growth higher than 1.0 percent. A very important aspect to look here is the coefficient of overconfident CEOs gradually increases as firms move to be more constrained. We thereby conclude that the impact of CEO overconfidence on firm employment increases more positively towards employment growth when a firm is financially constrained. We find the over-optimistic behaviour of overconfident CEOs in firm's HR policy and argue that they are highly optimistic during uncertain and risky circumstances (Griffin and Tversky, 1992).

As our fourth measure and third robustness check of expansion-contraction, we regress employment growth on overconfident CEOs for three equal sub samples categorized by ascending value of firm total asset. This proxies for life cycle of a firm and may influence employment growth rates and/or entry into a more mature, lower investment stage of the firm's life cycle. Smaller firms can also indicate the likelihood of cash flow challenges leading them to reduce investments. On the other hand, Jensen (1986) and Boot (1992) argue that larger firms are more prone to over-investment problem. We observe that CEO overconfidence has more impact on employment for firms that are smaller, i.e., more likely to be financially constrained. They have higher employment growth by 4.4 percent and 0.6 percent more likelihood for higher than 1.0 percent employment growth. They also show 10.7 percent less likely to have less than negative 1.0 percent employment growth in smaller firms compared to a non-overconfident CEO. Similar to what our previous results show, we observe the increased impact of CEO overconfidence in smaller firms (4.4 percent) compared to large firms (2.4 percent). We can associate with results with the optimistic nature of overconfident CEOs documented in the literature. We also highlight the corporate governance mechanism difference between small and large firms, which determines how much control a CEO have over the board. In our paper, "*Corporate Governance Structure for Overconfident CEOs: A look into Directors Structure, Blockholders and Change of auditors"* we conclude that overconfident CEOs prefers smaller board size, with younger directors, more co-opted directors, less blockholders and smaller auditors. All of these are more likely to be seen in smaller firms and thus we find increased CEOs power and control over corporate hiring decisions substantially in those firms.

[Table 5 and Table 6 from Appendix III (C) here]

6. Conclusions

Employment is a primary concern for politicians, individuals, and economists alike. For more than half a century economist have investigated how employment fluctuates with output. In this paper, we use eleven distinct metrics to calculate employment variations, such as net hiring (employment growth), net hiring dummy (which takes the value 1 if net hiring is more than 1.0 percent, 5 percent, 10 percent, 15 percent and 20 percent respectively) and Employee Reduction (which takes the value 1 if net hiring is less than minus 1.0 percent, minus 5.0 percent, minus10 percent, minus 15 percent and minus20 percent respectively). We test our first two hypothesis by regressing the eleven dependent variables on CEO overconfidence and a set of firm specific control variables. Our results are presented after taking several precautions to mitigate a variety of endogeneity concerns. Our tests use a diverse set of control variables, along with industry fixed effects (to control for time-invariant industry level variables) and year fixed effects. The results are also robust for all eleven dependent variables, three different measures of CEO overconfidence and a selection of level and change variables. For our third and fourth hypothesis, we use four different measure of industry expansion and contraction and use their interaction with CEO overconfidence as a control to determine its impact. First, we use a dummy variable, industry expansion, which takes the value 1 if last 3 years sales median of that industry is greater than zero. We observe that the interaction coefficient for overconfident CEOs is positive for net hiring and all five employment growth dummies, and negative for all five employment reduction dummies. Second, we use rolling cash flow volatility which measures the standard deviation of industry cashflow for last 5 years. With high cash volatility in the industry, we find overconfident CEOs to hire more and fire less than their peers. Third, we use firm Kaplan Zingales index and ascendingly rank the sample in three equal sub samples. We afterwards ran separate analysis on them and discover that CEO overconfidence gets more impactful and significantly positive to employment expansion when the firm is more financially constrained. These results are consistent with the literature arguing that overconfident CEOs are more optimistic from risky and uncertain decisions and directs us towards their overoptimistic nature. Finally, dividing the sample into three groups by ascending value of total asset, we run analysis and find overconfident CEOs, yet again are more likely to have larger employment growth in

smaller firms. They, however, have larger employment throughout three sub-samples, but the magnitudes are more in smaller constrained firms. We discover the increased corporate governance mechanism of larger firms to dominate the CEO, which restricts them to overrule board's decisions. Despite higher scrutiny, overconfident CEOs show greater employment growth in large firms compared to non-overconfident CEOs, highlighting that though lower but these CEOs still positively influence firm hiring decisions.

We provide a novel conclusion of positive association of CEO overconfidence with employment growth and this association gets stronger for financially constrained and smaller firms. For different economic cycles, we find they have more employment growth during expansion and less downsizing during contraction. We also conclude the increasing influence of CEO overconfidence for smaller firms and highlight how the different governance structure can influence CEOs HR decisions. Our finding can be used to map and forecast labor demand in the economy and align the resources accordingly.

Our findings add to the debate on the value implication of over-hiring and under-firing decisions and of CEOs' risk preferences. Some studies argue that sub-optimal investment in human resources is value destructive when CEOs prefer the quite life (Bertrand & Mullainathan, 2003), engage in empire building (Pagano & Volpin, 2005), or seek private benefits associated with forming relationship with workers (Atanassov & Kim, 2009). Yet, actions of optimistic and risk-taking CEOs might be value enhancing, not only because retaining workers in the bad time allows firms to save employment adjustment costs, retain firm-specific human capital, and boost morale, but also to allow firms to be prepared for future growth opportunities, which is consistent with the notion of maintaining optimal investment in employees (Ellul, Pagano, & Schivardi, 2018).

Our work adds a new perspective to the agency problems between CEOs and shareholders. By retaining workers in the bad time, which saves employment adjustment costs, retains firm-specific human capital, and boosts morale, optimistic CEOs may get firms to be better prepared for future growth opportunities. In this context, CEO's preferences could become more closely aligned with those of the

employees and of the shareholders. Given the recent attention from regulators and investors on disclosure of HRM policies, our work offers insights on the role of CEOs in designing, implementing and adopting effective HRM to boost firm performance.

This study has practical significance and implications. Understanding the link between CEO belief and human capital investment is strategically valuable to HR practitioners for designing selection/retention policy for CEOs and potentially for other top management position. Given that HR departments are responsible for planning and undertaking workforce adjustment actions such as recruitment and layoffs, such actions require that HR departments and boards of directors fully understand the rationale behind and factors that might influence decisions whether to expand or contract the workforce. Another implication of our study relates to firing decisions, i.e. negative employment growth, which extend beyond HR practitioners and boards of directors. As noted previously, reducing workforce when firms face adverse shocks such as decreasing sales growth could be seen as a means of improving profitability event in the short run (Atanassov & Kim, 2009; Ataullah et al., forthcoming). While such decisions could be received favourably by investors especially in the time of uncertainty and adversity, they often raise criticism from the public and negatively affect workers' morale and productivity (ibid.). Decisions not to reduce employment by CEOs with optimistic belief are important for workers, who are likely to lose jobs when their firms experience bad times, and for firm reputation.

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8. Tables

Table 1: Descriptive Statistics

This table presents summary statistics for the net hiring and firm characteristics variables used in our main analysis. The final sample consists of 4,812 CEOs, 3,859 Firms and 23,663 firm-year observations between 1995-2017. All variables are defined in Appendix III (B).

	Sample period (1995-2017)							
	Non-overconfident CEOs (N= 11,005)			*Overconfident CEOs* (N= 12,658)			*Difference*	
	Mean	*Median*	*Standard Deviation*	*Mean*	*Median*	*Standard Deviation*	*Mean*	*Median*
Employment variables:								
Net hiring	0.037	0.010	0.215	0.091	0.048	0.228	-0.054***	-0.038***
Firm characteristic							0.000***	0.000***
Lag_ Log (Employees)	8.510	8.537	1.665	8.404	8.476	1.690	0.106***	0.061***
Lag Employment	0.045	0.014	0.218	0.098	0.051	0.237	-0.053***	-0.037***
Lag Sales Growth	0.079	0.035	0.292	0.137	0.076	0.314	-0.058***	-0.041***
Lag RetVol	0.291	0.215	0.277	0.320	0.232	0.305	-0.029***	-0.017***
Δ *Lag Profit*	-0.272	-0.119	3.441	-0.110	-0.032	2.907	-0.162***	-0.087***
Δ *Lag Leverage*	0.319	0.000	2.260	0.369	-0.009	2.619	-0.050***	0.009***
Δ *Lag Quick Ratio*	0.062	-0.004	0.453	0.080	0.007	0.472	-0.018***	-0.011***
Δ *Lag CAPX Ratio*	0.076	-0.022	0.574	0.096	-0.009	0.593	-0.020***	-0.013***
Δ *Lag Q*	0.015	-0.005	0.286	0.050	0.018	0.326	-0.035***	-0.023***

Table 2: Regression Estimates and Marginal Effects for Employment Changes for Overconfident CEOs

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix III (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2i)	(2ii)	(3i)	(3ii)

	Net_Hiring	*Emp_Growth_01*	*Marginal Effects*	*Emp_Reduction_01*	*Marginal Effects*
OC_GS67	0.034***	0.495***	0.106***	-0.486***	-0.095***
	(11.80)	(14.00)	(14.31)	(-13.32)	(-13.52)
Lag Log (Employees)	-0.017***	-0.127***	-0.027***	0.090***	0.017***
	(-14.87)	(-9.44)	(-9.57)	(6.39)	(6.42)
Lag Employment Growth	0.130***	0.952***	0.204***	-0.899***	-0.175***
	(11.54)	(8.99)	(9.04)	(-7.67)	(-7.69)
Lag Sales Growth	0.085***	0.918***	0.196***	-0.959***	-0.187***
	(9.01)	(9.07)	(9.21)	(-8.34)	(-8.46)
Lag RetVol	0.016***	0.115**	0.025**	-0.080	-0.016
	(3.04)	(1.99)	(1.99)	(-1.31)	(-1.31)
Δ *Lag Profit*	0.001	0.014***	0.003***	-0.016***	-0.003***
	(1.63)	(3.10)	(3.10)	(-3.06)	(-3.06)
Δ *Lag Leverage*	-0.002***	-0.016***	-0.004***	0.019***	0.004***
	(-2.77)	(-2.74)	(-2.74)	(3.13)	(3.13)
Δ *Lag Quick Ratio*	0.037***	0.228***	0.049***	-0.221***	-0.043***
	(9.56)	(6.68)	(6.72)	(-5.88)	(-5.90)
Δ *Lag CAPX Ratio*	-0.001	-0.016	-0.003	0.020	0.004
	(-0.46)	(-0.59)	(-0.59)	(0.69)	(0.69)
Δ *Lag Q*	0.075***	0.792***	0.170***	-0.894***	-0.174***
	(12.76)	(13.91)	(14.20)	(-13.84)	(-14.14)
Constant	0.178***	0.449	N/A	-0.742***	N/A
	(5.96)	(1.04)		(-2.65)	
Observations	23,663	23,663	23,663	23,663	23663
Adjusted R^2	0.126	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.001	N/A	0.001	N/A
Correctly Classified	N/A	0.665	N/A	0.711	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Industry Expansion-Contraction (Median of Sales for Last Three Years)

The table presents the results of regression estimates and marginal effects for three measures of employment growth on CEO overconfidence during industry expansion-contraction. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Industry expansion is a dummy variable which takes the value 1 if industry sales growth median for last three years are greater than zero. Variable definitions are provided in the Appendix III (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2i)	(2ii)	(3i)	(3ii)
	Net_Hiring	*Emp_Growth_01*	*Marginal Effects*	*Emp_Reduction_01*	*Marginal Effects*
OC_GS67	0.026***	0.417***	0.089***	-0.441***	-0.086***
	(6.02)	(7.88)	(7.93)	(-7.99)	(-8.05)
Industry Expansion	-0.004	-0.018	-0.004	0.016	0.003
	(-0.78)	(-0.31)	(-0.31)	(0.28)	(0.28)
*OC_GS67*Industry Expansion*	0.013**	0.120*	0.026*	-0.069	-0.014
	(2.33)	(1.91)	(1.91)	(-1.05)	(-1.05)
Lag Log (Employees)	-0.017***	-0.127***	-0.027***	0.090***	0.017***
	(-14.88)	(-9.46)	(-9.58)	(6.39)	(6.42)
Lag Employment Growth	0.130***	0.951***	0.203***	-0.898***	-0.175***
	(11.52)	(8.98)	(9.03)	(-7.67)	(-7.69)
Lag Sales Growth	0.085***	0.914***	0.196***	-0.957***	-0.186***
	(8.99)	(9.05)	(9.19)	(-8.32)	(-8.45)
Lag RetVol	0.016***	0.112*	0.024*	-0.079	-0.015
	(2.98)	(1.95)	(1.95)	(-1.29)	(-1.29)
Δ *Lag Profit*	0.001	0.014***	0.003***	-0.016***	-0.003***
	(1.61)	(3.08)	(3.08)	(-3.05)	(-3.05)
Δ *Lag Leverage*	-0.002***	-0.016***	-0.004***	0.019***	0.004***
	(-2.77)	(-2.74)	(-2.74)	(3.13)	(3.13)
Δ *Lag Quick Ratio*	0.037***	0.227***	0.049***	-0.221***	-0.043***
	(9.54)	(6.66)	(6.69)	(-5.87)	(-5.89)
Δ *Lag CAPX Ratio*	-0.001	-0.017	-0.004	0.020	0.004
	(-0.49)	(-0.64)	(-0.64)	(0.72)	(0.72)
Δ *Lag Q*	0.075***	0.790***	0.169***	-0.893***	-0.174***
	(12.73)	(13.88)	(14.16)	(-13.82)	(-14.12)
Constant	0.180***	0.456	N/A	-0.751***	N/A
	(5.98)	(1.06)		(-2.67)	
Observations	23,663	23,663	23,663	23,663	23,663
Adjusted R^2	0.126	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.001	N/A	0.001	N/A
Correctly Classified	N/A	0.666	N/A	0.710	N/A

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Industry Expansion-Contraction (Cashflow Volatility for Lagged 5 Years)

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Cashflow volatility is the rolling standard deviation of past 4 years cashflow. Variable definitions are provided in the Appendix III (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses).

	(1) *Net_Hiring*	(2i) *Emp_Growth_01*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction_01*	(3ii) *Marginal Effects*
OC_GS67	0.030***	0.473***	0.101***	-0.471***	-0.091***
	(9.30)	(11.96)	(12.14)	(-11.51)	(-11.62)
CF Volatility,	-0.093***	-1.131***	-0.241***	1.319***	0.255***
	(-3.96)	(-5.75)	(-5.78)	(6.25)	(6.28)
OC_GS67 CF Volatility,*	0.042	0.231	0.049	-0.133	-0.026
	(1.53)	(1.01)	(1.01)	(-0.53)	(-0.53)
Lag Log (Employees)	-0.020***	-0.161***	-0.034***	0.132***	0.026***
	(-17.06)	(-11.19)	(-11.37)	(8.96)	(9.01)
Lag Employment Growth	0.128***	0.942***	0.201***	-0.895***	-0.173***
	(11.37)	(9.11)	(9.18)	(-7.90)	(-7.94)
Lag Sales Growth	0.091***	0.961***	0.205***	-0.992***	-0.192***
	(9.61)	(10.08)	(10.24)	(-9.41)	(-9.55)
Lag RetVol	0.018***	0.142**	0.030**	-0.114*	-0.022*
	(3.36)	(2.47)	(2.47)	(-1.87)	(-1.87)
Δ *Lag Profit*	0.001	0.014***	0.003***	-0.015***	-0.003***
	(1.54)	(2.99)	(2.99)	(-2.95)	(-2.96)
Δ *Lag Leverage*	-0.002***	-0.015**	-0.003**	0.018***	0.003***
	(-2.64)	(-2.57)	(-2.57)	(2.92)	(2.92)
Δ *Lag Quick Ratio*	0.038***	0.235***	0.050***	-0.231***	-0.045***
	(9.60)	(6.86)	(6.90)	(-6.13)	(-6.16)

Δ *Lag CAPX Ratio*	-0.001	-0.010	-0.002	0.012	0.002
	(-0.37)	(-0.37)	(-0.37)	(0.44)	(0.44)
Δ *Lag Q*	0.076***	0.804***	0.171***	-0.905***	-0.175***
	(12.91)	(14.26)	(14.56)	(-14.31)	(-14.62)
Constant	0.202***	0.778*	N/A	-1.155***	N/A
	(6.62)	(1.80)		(-3.97)	
Observations	23,654	23,654	23,654	23,654	23,654
Adjusted R^2	0.128	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.004	N/A	0.001	N/A
Correctly Classified	N/A	0.664	N/A	0.711	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Kaplan Zingales Index

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence during industry expansion and contraction. We divided our sample into three equal parts in the ascending order of KZ index to mark lowest to highest financially constrained firms. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix III (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses).

Panel I: Lowest Constraints Firms

	(1) *Net_Hiring*	(2i) *Emp_Growth_01*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction_01*	(3ii) *Marginal Effects*
OC_GS67	0.021***	0.389***	0.085***	-0.389***	-0.076***
	(4.83)	(6.85)	(6.92)	(-6.44)	(-6.48)
Lag Log (Employees)	-0.012***	-0.076***	-0.017***	0.058***	0.011***
	(-7.60)	(-3.68)	(-3.70)	(2.71)	(2.71)
Lag Employment Growth	0.178***	1.803***	0.394***	-1.782***	-0.346***

	(6.83)	(6.90)	(7.03)	(-6.13)	(-6.21)
Lag Sales Growth	0.040**	0.794***	0.173***	-0.905***	-0.176***
	(1.99)	(3.86)	(3.87)	(-3.64)	(-3.66)
Lag RetVol	0.020*	0.148	0.032	-0.138	-0.027
	(1.96)	(1.35)	(1.35)	(-1.14)	(-1.14)
Δ *Lag Profit*	0.001	0.008	0.002	-0.005	-0.001
	(0.67)	(0.78)	(0.78)	(-0.46)	(-0.46)
Δ *Lag Leverage*	-0.001	-0.010	-0.002	0.011	0.002
	(-1.11)	(-0.93)	(-0.93)	(0.90)	(0.90)
Δ *Lag Quick Ratio*	0.023***	0.213***	0.046***	-0.204***	-0.040***
	(3.75)	(3.18)	(3.19)	(-2.74)	(-2.75)
Δ *Lag CAPX Ratio*	-0.006	-0.099**	-0.022**	0.101**	0.020**
	(-1.35)	(-2.25)	(-2.25)	(2.10)	(2.11)
Δ *Lag Q*	0.048***	0.714***	0.156***	-0.922***	-0.179***
	(4.69)	(6.34)	(6.42)	(-7.36)	(-7.47)
Constant	0.087***	0.319	N/A	-0.515	N/A
	(3.32)	(0.59)		(-1.44)	
Observations	7,817	7,812	7,812	7,809	7,809
Adjusted R^2	0.084	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.009	N/A	0.004	N/A
Correctly Classified	N/A	0.653	N/A	0.709	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel II: Medium Constraints Firms

	(1) *Net_Hiring*	(2i) *Emp_Growth_01*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction_01*	(3ii) *Marginal Effects*
OC_GS67	0.036***	0.565***	0.116***	-0.549***	-0.102***
	(6.77)	(9.49)	(9.73)	(-8.85)	(-8.98)
Lag Log (Employees)	-0.021***	-0.177***	-0.036***	0.132***	0.024***
	(-10.26)	(-8.00)	(-8.18)	(5.47)	(5.51)
Lag Employment Growth	0.114***	0.889***	0.183***	-0.907***	-0.168***
	(5.91)	(4.52)	(4.53)	(-4.21)	(-4.21)
Lag Sales Growth	0.098***	1.209***	0.249***	-1.300***	-0.241***
	(5.73)	(6.11)	(6.22)	(-6.14)	(-6.25)
Lag RetVol	0.008	0.096	0.020	-0.111	-0.021
	(0.86)	(0.97)	(0.97)	(-1.08)	(-1.08)
Δ *Lag Profit*	0.002**	0.026***	0.005***	-0.023**	-0.004**
	(2.42)	(2.97)	(2.98)	(-2.37)	(-2.38)
Δ *Lag Leverage*	-0.002	-0.021**	-0.004**	0.023**	0.004**
	(-1.64)	(-2.01)	(-2.01)	(2.19)	(2.19)
Δ *Lag Quick Ratio*	0.037***	0.238***	0.049***	-0.211***	-0.039***
	(5.32)	(3.78)	(3.79)	(-3.14)	(-3.15)
Δ *Lag CAPX Ratio*	-0.008	-0.045	-0.009	0.051	0.010
	(-1.64)	(-0.90)	(-0.90)	(0.96)	(0.96)
Δ *Lag Q*	0.062***	0.710***	0.146***	-0.829***	-0.153***
	(6.19)	(7.14)	(7.24)	(-7.40)	(-7.49)
Constant	0.241***	1.804***	N/A	-1.757**	N/A
	(5.65)	(4.27)		(-2.52)	
Observations	7,817	7,815	7,815	7,815	7,815
Adjusted R^2	0.122	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.004	N/A	0.007	N/A
Correctly Classified	N/A	0.709	N/A	0.682	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel III: Highest Constraints Firms

	(1) *Net_Hiring*	(2i) *Emp_Growth_01*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction_01*	(3ii) *Marginal Effects*
OC_GS67	0.047***	0.583***	0.121***	-0.600***	-0.117***
	(8.42)	(9.82)	(10.16)	(-9.99)	(-10.28)
Lag Log (Employees)	-0.021***	-0.151***	-0.031***	0.114***	0.022***
	(-9.19)	(-6.12)	(-6.22)	(4.54)	(4.57)
Lag Employment Growth	0.118***	0.733***	0.153***	-0.660***	-0.129***
	(7.67)	(5.43)	(5.45)	(-4.59)	(-4.60)
Lag Sales Growth	0.091***	0.825***	0.172***	-0.856***	-0.167***
	(7.40)	(6.24)	(6.37)	(-5.85)	(-5.97)
Lag RetVol	0.022**	0.179*	0.037*	-0.121	-0.024
	(2.40)	(1.93)	(1.93)	(-1.29)	(-1.29)
Δ *Lag Profit*	-0.000	0.009	0.002	-0.014*	-0.003*
	(-0.11)	(1.27)	(1.27)	(-1.95)	(-1.95)
Δ *Lag Leverage*	-0.002**	-0.012	-0.002	0.015	0.003
	(-2.04)	(-1.22)	(-1.22)	(1.54)	(1.55)
Δ *Lag Quick Ratio*	0.047***	0.244***	0.051***	-0.236***	-0.046***
	(6.91)	(4.34)	(4.35)	(-3.89)	(-3.91)
Δ *Lag CAPX Ratio*	0.006	0.053	0.011	-0.032	-0.006
	(1.16)	(1.15)	(1.15)	(-0.66)	(-0.66)
Δ *Lag Q*	0.098***	0.923***	0.192***	-0.996***	-0.194***
	(10.03)	(9.97)	(10.29)	(-9.55)	(-9.87)
Constant	0.248***	-0.193	N/A	-0.618*	N/A
	(4.26)	(-0.36)		(-1.88)	
Observations	7,818	7,813	7,813	7,813	7,813
Adjusted R^2	0.157	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.001	N/A	0.013	N/A
Correctly Classified	N/A	0,728	N/A	0.679	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Total Assets

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence during industry expansion and contraction. We use firm's total asset to make three equal sub samples in ascending order of the value. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Variable definitions are provided in the Appendix III (B). All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses).

Panel I: Small Firms

	(1) *Net_Hiring*	(2i) *Emp_Growth_01*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction_01*	(3ii) *Marginal Effects*
OC_GS67	0.044***	0.037	0.006	-0.583***	-0.107***
	(7.48)	(0.05)	(0.05)	(-9.45)	(-9.66)
Lag Log (Employees)	-0.027***	-0.123	-0.021	0.079**	0.015**
	(-7.86)	(-0.26)	(-0.26)	(2.33)	(2.34)
Lag Employment Growth	0.190***	3.451***	0.599***	-1.403***	-0.259***
	(9.49)	(3.26)	(3.91)	(-6.95)	(-7.04)
Lag Sales Growth	0.091***	0.550	0.095	-0.763***	-0.141***
	(6.64)	(1.38)	(1.44)	(-4.67)	(-4.72)
Lag RetVol	0.022**	1.397*	0.242**	-0.085	-0.016
	(2.45)	(1.77)	(1.98)	(-0.93)	(-0.93)
Δ *Lag Profit*	-0.001	0.090	0.016	0.001	0.000
	(-0.89)	(1.28)	(1.28)	(0.07)	(0.07)
Δ *Lag Leverage*	-0.003**	0.171	0.030	0.036***	0.007***
	(-2.45)	(0.83)	(0.84)	(3.97)	(3.97)
Δ *Lag Quick Ratio*	0.044***	0.403	0.070	-0.234***	-0.043***
	(7.13)	(1.20)	(1.27)	(-3.76)	(-3.79)
Δ *Lag CAPX Ratio*	-0.005	-0.120	-0.021	0.056	0.010
	(-1.24)	(-0.52)	(-0.52)	(1.49)	(1.49)
Δ *Lag Q*	0.056***	0.345	0.060	-0.522***	-0.096***

	(6.60)	(0.58)	(0.58)	(-6.36)	(-6.41)
Constant	0.236***	2.217	N/A	-0.382	N/A
	(2.96)	(0.82)		(-1.40)	
Observations	7,887	7,878	7,878	7,878	7,878
Adjusted R^2	0.149	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.007	N/A	0.001	N/A
Correctly Classified	N/A	0.750	N/A	0.728	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel II: Medium Firms

	(1) *Net_Hiring*	(2i) *Emp_Growth_01*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction_01*	(3ii) *Marginal Effects*
OC_GS67	0.035***	0.479***	0.101***	-0.486***	-0.091***
	(7.20)	(8.03)	(8.17)	(-7.80)	(-7.89)
Lag Log (Employees)	-0.031***	-0.182***	-0.038***	0.155***	0.029***
	(-9.33)	(-5.44)	(-5.49)	(4.16)	(4.18)
Lag Employment Growth	0.114***	0.958***	0.202***	-0.829***	-0.155***
	(5.70)	(5.01)	(5.04)	(-4.03)	(-4.04)
Lag Sales Growth	0.085***	1.207***	0.254***	-1.200***	-0.225***
	(4.76)	(6.20)	(6.30)	(-5.75)	(-5.83)
Lag RetVol	0.006	0.112	0.024	-0.047	-0.009
	(0.61)	(1.09)	(1.09)	(-0.43)	(-0.43)
Δ *Lag Profit*	0.001	0.019**	0.004**	-0.019**	-0.004**
	(1.49)	(2.18)	(2.18)	(-1.96)	(-1.97)
Δ *Lag Leverage*	-0.001	-0.003	-0.001	0.005	0.001
	(-0.90)	(-0.31)	(-0.31)	(0.43)	(0.43)
Δ *Lag Quick Ratio*	0.033***	0.212***	0.045***	-0.207***	-0.039***
	(4.84)	(3.64)	(3.65)	(-3.13)	(-3.13)
Δ *Lag CAPX Ratio*	-0.000	-0.017	-0.004	0.009	0.002
	(-0.07)	(-0.36)	(-0.36)	(0.18)	(0.18)
Δ *Lag Q*	0.095***	1.090***	0.230***	-1.307***	-0.245***
	(8.59)	(9.38)	(9.63)	(-9.91)	(-10.24)

Constant	0.304***	-0.253	N/A	-1.743***	N/A
	(7.43)	(-0.51)		(-3.76)	
Observations	7,888	7,888	7,888	7,888	7,888
Adjusted R^2	0.135	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.004	N/A	0.001	N/A
Correctly Classified	N/A	0.668	N/A	0.722	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel III: Largest Firms

	(1) *Net_Hiring*	(2i) *Emp_Growth_01*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction_01*	(3ii) *Marginal Effects*
OC_GS67	0.024***	0.451***	0.098***	-0.428***	-0.087***
	(5.44)	(7.32)	(7.42)	(-6.81)	(-6.87)
Lag Log (Employees)	-0.020***	-0.205***	-0.045***	0.160***	0.032***
	(-8.55)	(-6.56)	(-6.65)	(4.75)	(4.78)
Lag Employment Growth	0.067***	0.581***	0.126***	-0.460**	-0.093**
	(4.19)	(3.57)	(3.58)	(-2.56)	(-2.56)
Lag Sales Growth	0.070***	0.871***	0.190***	-1.079***	-0.219***
	(4.61)	(5.32)	(5.37)	(-5.79)	(-5.86)
Lag RetVol	0.014*	0.106	0.023	-0.099	-0.020
	(1.66)	(0.94)	(0.94)	(-0.82)	(-0.82)
Δ *Lag Profit*	0.002***	0.031***	0.007***	-0.034***	-0.007***
	(3.68)	(3.43)	(3.44)	(-3.51)	(-3.52)
Δ *Lag Leverage*	-0.001	-0.001	-0.000	0.006	0.001
	(-1.09)	(-0.10)	(-0.10)	(0.43)	(0.43)
Δ *Lag Quick Ratio*	0.023***	0.193***	0.042***	-0.198***	-0.040***
	(3.71)	(2.84)	(2.85)	(-2.89)	(-2.90)
Δ *Lag CAPX Ratio*	0.005	0.071	0.015	-0.048	-0.010
	(0.82)	(1.02)	(1.02)	(-0.63)	(-0.63)
Δ *Lag Q*	0.103***	1.504***	0.327***	-1.580***	-0.321***

	(8.27)	(11.66)	(12.10)	(-11.02)	(-11.38)
Constant	0.196***	1.424**	N/A	-1.492***	N/A
	(5.77)	(1.96)		(-2.60)	
Observations	7,888	7,882	7,882	7,882	7,882
Adjusted R^2	0.081	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.110	N/A	0.026	N/A
Correctly Classified	N/A	0.652	N/A	0.687	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Robustness Check for Overconfidence Measure Using Galasso and Simcoe (2011) With 100% in-the-money

Table 7, panel I depicts the regression estimates and marginal effects for net hiring, employment growth and reduction dummies. It shows that overconfident CEOs had a greater rate of job growth and a lower percentage of job termination. Columns 1-2ii represent a rise in employment, whereas columns 3i-3ii shows a decrease in employment. When job growth exceeds 1.0 percent, column 2i employment growth represents a dummy 1, and when employment shrinking is less than minus 1.0 percent, column 4 employment reduction shows a dummy 1 and 0 otherwise. Overconfident CEOs show a positive significant relationship with both the absolute and net hiring dummies, confirming our first hypothesis that overconfident CEOs have greater employment growth than their peers. CEOs who are overconfident have a 3.5 percent higher rate of employment growth and are 10.9 percent more likely to have a 1.0 percent or higher rate of employment growth. Higher lagged employment growth, lagged sales growth, stock return volatility, change in net profit, change in quick ratio, change in capital expenditure ratio, and change in Tobin's Q are all associated with this rise. As expected, higher employment is accompanied by a decrease in leverage change.

Column 3i backs up our second hypothesis, which states that overconfidence in the CEO leads to a lower drop in employment. If employment growth is less than minus 1.0 percent, we use a dummy with the value 1 to represent a decline in employment and 0 otherwise. Overconfident CEOs are 9.6 percent less likely to experience a negative 1.0 percent employment growth, according to the findings. Lower lagged employment growth, lagged sales growth, change in net profit, change in Quick ratio, and change in Tobin's Q are politely correlated with employment growth. On the other side, it's linked to more leverage change and a larger capital expenditure ratio.

Panel I: Regression Estimates and Marginal Effects for Employment Changes for Overconfident CEOs

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if s/he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2i)	(2ii)	(3i)	(3ii)
	Net_Hiring	*Emp_Growth_01*	*Marginal Effects*	*Emp_Reduction_01*	*Marginal Effects*
OC_GS100	0.035***	0.511***	0.109***	-0.494***	-0.096***
	(11.57)	(13.99)	(14.31)	(-13.13)	(-13.31)
Lag Log (Employees)	-0.017***	-0.120***	-0.026***	0.083***	0.016***
	(-14.46)	(-8.89)	(-8.99)	(5.91)	(5.94)
Lag Employment Growth	0.130***	0.959***	0.205***	-0.910***	-0.177***
	(11.53)	(9.04)	(9.09)	(-7.74)	(-7.76)
Lag Sales Growth	0.085***	0.904***	0.193***	-0.947***	-0.185***
	(8.94)	(8.95)	(9.09)	(-8.23)	(-8.34)
Lag RetVol	0.015***	0.102*	0.022*	-0.069	-0.013
	(2.89)	(1.78)	(1.78)	(-1.14)	(-1.14)
Δ *Lag Profit*	0.001*	0.015***	0.003***	-0.016***	-0.003***
	(1.69)	(3.18)	(3.18)	(-3.13)	(-3.14)
Δ *Lag Leverage*	-0.002***	-0.017***	-0.004***	0.019***	0.004***
	(-2.82)	(-2.81)	(-2.81)	(3.19)	(3.19)
Δ *Lag Quick Ratio*	0.037***	0.228***	0.049***	-0.222***	-0.043***
	(9.55)	(6.73)	(6.76)	(-5.92)	(-5.94)
Δ *Lag CAPX Ratio*	-0.001	-0.014	-0.003	0.018	0.004
	(-0.41)	(-0.52)	(-0.52)	(0.64)	(0.64)
Δ *Lag Q*	0.075***	0.795***	0.170***	-0.900***	-0.175***
	(12.80)	(13.95)	(14.23)	(-13.90)	(-14.20)
Constant	0.174***	0.392	N/A	-0.688**	N/A
	(5.82)	(0.90)		(-2.45)	
Observations	23,663	23,663	23,663	23,663	23,663
Adjusted R^2	0.126	N/A	N/A	N/A	N/A

Pearson Chi²	N/A	0.001	N/A	0.001	N/A
Correctly Classified	N/A	0.665	N/A	0.708	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To confirm third and fourth hypothesis, we utilize the industry sales median for the last three years as the first metric, and we count dummy industry expansion as 1 if the three lagged medians are larger than zero. We interact CEO overconfidence with industry expansion dummy and monitor the interaction coefficient to assess the influence of overconfident CEOs on company employment during industry expansion. The interaction term of CEO overconfidence and industry expansion has a positive coefficient for net hiring in Column 1-2ii, where we assess employment growth. It indicates that overconfident CEOs have 1.5 percent higher employment growth during an industry expansion. The findings support Mankiw's (2012) and Ball et al (2013)'s findings that show a positive relationship between economic growth and employment growth. The dependent variable, Emp Reduction, which reflects minus 1.0 percent employment growth, is then regressed to further investigate our fourth hypothesis, showing that overconfident CEOs are 1.1 percent less likely for an employment reduction.

Panel II: Industry Expansion-Contraction (Median of Sales)

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Industry expansion is a dummy variable which takes the value 1 if industry sales median for last three years were greater than zero. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) *Net_Hiring*	(2i) *Emp_Growth_01*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction_01*	(3ii) *Marginal Effects*
OC_GS100	0.025***	0.451***	0.097***	-0.457***	-0.089***
	(5.63)	(8.12)	(8.19)	(-7.78)	(-7.83)
Industry Expansion	-0.003	0.017	0.004	-0.005	-0.001
	(-0.57)	(0.32)	(0.32)	(-0.09)	(-0.09)
*OC_GS100*Industry Expansion*	0.015***	0.091	0.019	-0.056	-0.011
	(2.63)	(1.40)	(1.40)	(-0.80)	(-0.80)
Lag Log (Employees)	-0.017***	-0.120***	-0.026***	0.083***	0.016***
	(-14.47)	(-8.89)	(-9.00)	(5.92)	(5.94)

Lag Employment Growth	0.130***	0.957***	0.205***	-0.909***	-0.177***
	(11.51)	(9.03)	(9.08)	(-7.73)	(-7.76)
Lag Sales Growth	0.085***	0.900***	0.193***	-0.945***	-0.184***
	(8.92)	(8.93)	(9.07)	(-8.21)	(-8.33)
Lag RetVol	0.015***	0.101*	0.022*	-0.069	-0.013
	(2.87)	(1.77)	(1.77)	(-1.13)	(-1.13)
Δ *Lag Profit*	0.001*	0.015***	0.003***	-0.016***	-0.003***
	(1.68)	(3.17)	(3.17)	(-3.13)	(-3.14)
Δ *Lag Leverage*	-0.002***	-0.017***	-0.004***	0.019***	0.004***
	(-2.81)	(-2.81)	(-2.81)	(3.19)	(3.18)
Δ *Lag Quick Ratio*	0.037***	0.228***	0.049***	-0.222***	-0.043***
	(9.52)	(6.71)	(6.74)	(-5.91)	(-5.93)
Δ *Lag CAPX Ratio*	-0.001	-0.015	-0.003	0.019	0.004
	(-0.43)	(-0.56)	(-0.56)	(0.66)	(0.66)
Δ *Lag Q*	0.075***	0.794***	0.170***	-0.899***	-0.175***
	(12.78)	(13.93)	(14.22)	(-13.89)	(-14.19)
Constant	0.176***	0.373	N/A	-0.681**	N/A
	(5.83)	(0.86)		(-2.41)	
Observations	23,663	23,663	23,663	23,663	23,663
Adjusted R^2	0.126	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.001	N/A	0.001	N/A
Correctly Classified	N/A	0.665	N/A	0.709	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 7 panel III, we utilize rolling lagged cash flow volatility as a second metric to evaluate industry expansion/contraction as a robustness check to our third and fourth hypotheses. Cashflow volatility is computed as the rolling standard deviation of the previous four years' cashflow; that is, the standard deviation of five years' worth of cashflow, where cashflow is calculated as Operating Income Before Depreciation scaled by net assets (total assets minus cash and marketable securities). The coefficient for CEO overconfidence and Cashflow volatility interaction is positive, validating our prediction that an overconfident CEO has a 2.9 percent increase in job growth during a downturn in the industry. Overconfident CEOs are 0.5 percent more likely to have employment growth that exceeds 1.0 percent.

Panel III: Industry Expansion-Contraction (Cashflow Volatility for Lagged 5 Years)

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Cashflow volatility is the rolling standard deviation of past 4 years cashflow. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2i)	(2ii)	(3i)	(3ii)
	Net_Hiring	*Emp_Growth_01*	*Marginal Effects*	*Emp_Reduction_01*	*Marginal Effects*
OC_GS100	0.032***	0.508***	0.108***	-0.500***	-0.097***
	(9.56)	(12.45)	(12.64)	(-11.92)	(-12.03)
CF Volatility,	-0.083***	-1.003***	-0.214***	1.202***	0.233***
	(-4.02)	(-5.30)	(-5.33)	(6.21)	(6.24)
OC_GS100 CF Volatility,*	0.029	-0.025	-0.005	0.130	0.025
	(1.04)	(-0.10)	(-0.10)	(0.52)	(0.52)
Lag Log (Employees)	-0.019***	-0.154***	-0.033***	0.125***	0.024***
	(-16.68)	(-10.70)	(-10.85)	(8.52)	(8.56)
Lag Employment Growth	0.128***	0.950***	0.203***	-0.907***	-0.176***
	(11.36)	(9.16)	(9.24)	(-7.98)	(-8.02)
Lag Sales Growth	0.090***	0.947***	0.202***	-0.981***	-0.190***
	(9.55)	(9.98)	(10.13)	(-9.32)	(-9.45)
Lag RetVol	0.017***	0.130**	0.028**	-0.103*	-0.020*
	(3.22)	(2.26)	(2.26)	(-1.69)	(-1.69)
Δ *Lag Profit*	0.001	0.014***	0.003***	-0.016***	-0.003***
	(1.62)	(3.07)	(3.08)	(-3.03)	(-3.04)
Δ *Lag Leverage*	-0.002***	-0.016***	-0.003***	0.018***	0.004***
	(-2.71)	(-2.66)	(-2.66)	(3.00)	(3.00)
Δ *Lag Quick Ratio*	0.038***	0.236***	0.050***	-0.232***	-0.045***
	(9.59)	(6.91)	(6.95)	(-6.18)	(-6.21)
Δ *Lag CAPX Ratio*	-0.001	-0.008	-0.002	0.011	0.002
	(-0.32)	(-0.29)	(-0.29)	(0.38)	(0.38)

Δ *Lag Q*	0.076***	0.807***	0.172***	-0.910***	-0.176***
	(12.96)	(14.32)	(14.62)	(-14.39)	(-14.70)
Constant	0.198***	0.715	N/A	-1.096***	N/A
	(6.49)	(1.64)		(-3.75)	
Observations	23,654	23,654	23,654	23,654	23,654
Adjusted R^2	0.127	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.004	N/A	0.001	N/A
Correctly Classified	N/A	0.664	N/A	0.709	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Robustness Check for Overconfidence Measure Using Malmendier and Tate (2005) With 67% in-the-money

Table 8, panel I depicts the regression estimates and marginal effects for net hiring, employment growth and reduction dummies. It shows that overconfident CEOs had a greater rate of job growth and a lower percentage of job termination. Columns 1-2ii represent a rise in employment, whereas columns 3i-3ii show a decrease in employment. When job growth exceeds 1.0 percent, column 2i represents a dummy 1, and when employment shrinking is less than minus 1.0 percent, column 4 shows a dummy 1 and o otherwise. Overconfident CEOs show a positive significant relationship with both the absolute and net hiring dummies, confirming our first hypothesis that overconfident CEOs have greater employment growth than their peers. CEOs who are overconfident have a 3.2 percent higher rate of employment growth and are 9.8 percent more likely to have a 1.0 percent or higher rate of employment growth. Higher lagged employment growth, lagged sales growth, change in net profit, change in quick ratio, change in capital expenditure ratio, stock return volatility, and change in Tobin's Q are all associated with this rise. As expected, higher employment is accompanied by a decrease in leverage change.

Column 3i backs up our second hypothesis, which states that overconfidence in the CEO leads to a lower drop in employment. If employment growth is less than minus 1.0 percent, we use a dummy with the value 1 to represent a decline in employment and 0 otherwise. Overconfident CEOs are 8.9 percent less likely to experience a negative 1.0 percent employment growth, according to the findings. Lower lagged employment growth, lagged sales growth, stock return volatility, change in net profit, change in Quick ratio, and change in Tobin's Q are all indicators of this possibility. On the other side, it's linked to more leverage change and a larger capital expenditure ratio.

Panel I: Regression Estimates and Marginal Effects for Employment Changes for Overconfident CEOs

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2i)	(2ii)	(3i)	(3ii)
	Net_Hiring	*Emp_Growth_01*	*Marginal Effects*	*Emp_Reduction_01*	*Marginal Effects*
OC_MT67	0.032***	0.457***	0.098***	-0.457***	-0.089***
	(11.01)	(13.19)	(13.43)	(-12.75)	(-12.90)
Lag Log (Employees)	-0.018***	-0.129***	-0.028***	0.092***	0.018***
	(-14.98)	(-9.57)	(-9.70)	(6.54)	(6.57)
Lag Employment Growth	0.130***	0.938***	0.201***	-0.884***	-0.173***
	(11.44)	(8.84)	(8.89)	(-7.53)	(-7.54)
Lag Sales Growth	0.086***	0.933***	0.200***	-0.974***	-0.190***
	(9.09)	(9.19)	(9.34)	(-8.44)	(-8.57)
Lag RetVol	0.016***	0.109*	0.023*	-0.073	-0.014
	(2.95)	(1.89)	(1.89)	(-1.21)	(-1.21)
Δ *Lag Profit*	0.001	0.014***	0.003***	-0.016***	-0.003***
	(1.63)	(3.08)	(3.09)	(-3.05)	(-3.05)
Δ *Lag Leverage*	-0.002***	-0.016***	-0.004***	0.019***	0.004***
	(-2.77)	(-2.72)	(-2.72)	(3.11)	(3.10)
Δ *Lag Quick Ratio*	0.037***	0.229***	0.049***	-0.222***	-0.043***
	(9.57)	(6.71)	(6.74)	(-5.90)	(-5.92)
Δ *Lag CAPX Ratio*	-0.001	-0.016	-0.004	0.021	0.004
	(-0.48)	(-0.63)	(-0.63)	(0.74)	(0.74)
Δ *Lag Q*	0.077***	0.814***	0.175***	-0.917***	-0.179***
	(12.99)	(14.31)	(14.61)	(-14.19)	(-14.50)

Constant	0.183***	0.514	N/A	-0.807***	N/A
	(6.10)	(1.19)		(-2.85)	
Observations	23,663	23,663	23,663	23,663	23,663
Adjusted R^2	0.125	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.001	N/A	0.001	N/A
Correctly Classified	N/A	0.663	N/A	0.709	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To confirm third and fourth hypothesis, we utilize the industry sales median for the last three years as the first metric, and we count dummy industry expansion as 1 if the three lagged medians are larger than zero. We then interact CEO overconfidence with industry expansion and monitor the interaction coefficient to assess the influence of overconfident CEOs on company employment during industry expansion. The interaction term of CEO overconfidence and industry expansion has a positive coefficient for net hiring in Column 1-2ii, where we assess employment growth. It indicates that overconfident CEOs have 1.2 percent higher employment growth during an industry expansion and their probability increases by 2.7 percent for growth over 1.0 percent. The findings support Mankiw's (2012) and Ball et al (2013)'s findings that show a positive relationship between economic growth and employment growth. The dependent variable, Emp Reduction, which reflects minus 1.0 percent employment growth, is then regressed to further investigate our fourth hypothesis, showing that overconfident CEOs are 0.9 percent less likely for an employment reduction.

Panel II: Industry Expansion-Contraction (Median of Sales for Last Three Years)

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Industry expansion is a dummy variable which takes the value 1 if industry sales median for last three years were greater than zero. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2i)	(2ii)	(3i)	(3ii)
	Net_Hiring	*Emp_Growth_01*	*Marginal Effects*	*Emp_Reduction_01*	*Marginal Effects*
OC_MT67	0.024***	0.375***	0.080***	-0.428***	-0.083***
	(5.49)	(6.96)	(7.00)	(-7.61)	(-7.66)

Industry Expansion	-0.003	-0.006	-0.001	-0.001	-0.000
	(-0.52)	(-0.11)	(-0.11)	(-0.02)	(-0.02)
*OC_MT67*Industry Expansion*	0.012**	0.125**	0.027**	-0.045	-0.009
	(2.24)	(1.99)	(1.99)	(-0.68)	(-0.68)
Lag Log (Employees)	-0.018***	-0.130***	-0.028***	0.092***	0.018***
	(-15.00)	(-9.61)	(-9.74)	(6.55)	(6.59)
Lag Employment Growth	0.129***	0.936***	0.201***	-0.883***	-0.172***
	(11.43)	(8.84)	(8.89)	(-7.53)	(-7.54)
Lag Sales Growth	0.086***	0.929***	0.199***	-0.972***	-0.190***
	(9.06)	(9.17)	(9.32)	(-8.43)	(-8.56)
Lag RetVol	0.016***	0.107*	0.023*	-0.073	-0.014
	(2.92)	(1.86)	(1.86)	(-1.19)	(-1.19)
Δ *Lag Profit*	0.001	0.014***	0.003***	-0.016***	-0.003***
	(1.61)	(3.06)	(3.07)	(-3.04)	(-3.05)
Δ *Lag Leverage*	-0.002***	-0.016***	-0.004***	0.019***	0.004***
	(-2.76)	(-2.72)	(-2.72)	(3.10)	(3.10)
Δ *Lag Quick Ratio*	0.037***	0.228***	0.049***	-0.222***	-0.043***
	(9.56)	(6.69)	(6.72)	(-5.89)	(-5.91)
Δ *Lag CAPX Ratio*	-0.001	-0.018	-0.004	0.021	0.004
	(-0.51)	(-0.68)	(-0.68)	(0.76)	(0.76)
Δ *Lag Q*	0.077***	0.813***	0.174***	-0.917***	-0.179***
	(12.96)	(14.28)	(14.58)	(-14.17)	(-14.49)
Constant	0.185***	0.520	N/A	-0.806***	N/A
	(6.12)	(1.20)		(-2.83)	
Observations	23,663	23,663	23,663	23,663	23,663
Adjusted R^2	0.125	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.001	N/A	0.001	N/A
Correctly Classified	N/A	0.663	N/A	0.710	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 8 panel III, we utilize rolling lagged cash flow volatility as a second metric to evaluate industry expansion/contraction and as a robustness check to our third and fourth hypotheses. Cashflow volatility is computed as the rolling standard deviation of the previous four years' cashflow; that is, the standard deviation of five years' worth of cashflow, where cashflow is calculated as Operating Income

Before Depreciation scaled by net assets (total assets minus cash and marketable securities). The coefficient for CEO overconfidence is positive, validating our prediction that an overconfident CEO has a 4.5 percent increase in job growth during a downturn in the industry. Overconfident CEOs are 0.1 percent more likely to have employment growth that exceeds 1.0 percent. Another dependent variable, Emp Reduction, supports our hypothesis by indicating that overconfident CEOs are less likely to reduce company labor by 0.2 percent.

Panel III: Industry Expansion-Contraction (Cashflow Volatility for Lagged 5 Years)

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Cashflow volatility is the rolling standard deviation of lagged 5 years cashflow. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) *Net_Hiring*	(2i) *Emp_Growth_01*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction_01*	(3ii) *Marginal Effects*
OC_MT67	0.028***	0.453***	0.097***	-0.462***	-0.090***
	(8.64)	(11.79)	(11.94)	(-11.59)	(-11.68)
CF Volatility,	-0.089***	-1.024***	-0.219***	1.223***	0.237***
	(-4.52)	(-5.72)	(-5.75)	(6.67)	(6.71)
OC_MT67 CF Volatility,*	0.045	0.005	0.001	0.105	0.020
	(1.54)	(0.02)	(0.02)	(0.41)	(0.41)
Lag Log (Employees)	-0.020***	-0.163***	-0.035***	0.135***	0.026***
	(-17.20)	(-11.34)	(-11.53)	(9.12)	(9.18)
Lag Employment Growth	0.127***	0.930***	0.199***	-0.884***	-0.171***
	(11.26)	(8.98)	(9.04)	(-7.77)	(-7.81)
Lag Sales Growth	0.092***	0.974***	0.208***	-1.005***	-0.195***
	(9.73)	(10.20)	(10.37)	(-9.50)	(-9.65)
Lag RetVol	0.017***	0.136**	0.029**	-0.107*	-0.021*

	(3.28)	(2.37)	(2.37)	(-1.76)	(-1.76)
Δ *Lag Profit*	0.001	0.014***	0.003***	-0.015***	-0.003***
	(1.54)	(2.98)	(2.98)	(-2.95)	(-2.96)
Δ *Lag Leverage*	-0.002***	-0.016***	-0.003***	0.018***	0.003***
	(-2.66)	(-2.58)	(-2.58)	(2.92)	(2.92)
Δ *Lag Quick Ratio*	0.038***	0.236***	0.050***	-0.233***	-0.045***
	(9.61)	(6.89)	(6.93)	(-6.16)	(-6.19)
Δ *Lag CAPX Ratio*	-0.001	-0.010	-0.002	0.013	0.002
	(-0.41)	(-0.39)	(-0.39)	(0.46)	(0.46)
Δ *Lag Q*	0.078***	0.826***	0.177***	-0.927***	-0.180***
	(13.15)	(14.67)	(14.99)	(-14.67)	(-15.00)
Constant	0.207***	0.840*	N/A	-1.218***	N/A
	(6.76)	(1.93)		(-4.13)	
Observations	23,654	23,654	23,654	23,654	23,654
Adjusted R^2	0.127	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.004	N/A	0.001	N/A
Correctly Classified	N/A	0.662	N/A	0.709	N/A

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Robustness Check for With Level Regression Using Galasso and Simcoe (2011) With 67% in-the-money

Table 9, panel I depicts the regression estimates and marginal effects for employment dummies in a level regression analysis. It shows that overconfident CEOs had a greater rate of job growth and a lower percentage of job termination. Columns 1-2ii represent a rise in employment, whereas columns 3i-3ii show a decrease in employment. When job growth exceeds 1.0 percent, column 2 represents a dummy 1, and when employment shrinking is less than minus 1.0 percent, column 5 shows a dummy 1 and 0otherwise. Overconfident CEOs show a positive significant relationship with both the actual and net hiring dummies, confirming our first hypothesis that overconfident CEOs have greater employment growth than their peers. CEOs who are overconfident have a 1.9 percent higher rate of employment growth and are 6.9 percent more likely to have a 1.0 percent or higher rate of employment growth. Higher lagged employment growth, lagged sales growth, change in net profit, change in quick ratio, change in capital expenditure ratio, stock return volatility, and change in Tobin's Q are all associated with this rise. As expected, higher employment is accompanied by a decrease in leverage change.

Column 3i backs up our second hypothesis, which states that overconfidence in the CEO leads to a lower drop in employment. If employment growth is less than minus 1.0 percent, we use a dummy with the value 1 to represent a decline in employment. Overconfident CEOs are 4.4 percent less likely to experience a negative 1.0 percent employment growth, according to the findings. Lower lagged employment growth, lagged sales growth, change in net profit, change in Quick ratio, and change in Tobin's Q are all indicators of this possibility. On the other side, it's linked to more leverage change, a larger capital expenditure ratio, and a greater stock return volatility ratio.

Panel I: Regression Estimates and Marginal Effects for Employment Changes for Overconfident CEOs

The table presents the results of regression estimates and marginal effects of five measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2i)	(2ii)	(3i)	(3ii)
	Net_Hiring	*Emp_Growth_01*	*Marginal Effects*	*Emp_Reduction_01*	*Marginal Effects*
OC_GS67	0.019***	0.371***	0.069***	-0.338***	-0.056***
	(7.37)	(10.17)	(10.12)	(-9.03)	(-8.97)
Sales Growth	0.433***	4.605***	0.852***	-4.580***	-0.759***
	(24.79)	(17.41)	(20.49)	(-17.24)	(-20.09)
Profit	0.107***	2.642***	0.489***	-3.265***	-0.541***
	(6.27)	(11.41)	(11.70)	(-13.89)	(-14.43)
Δ *Lag Profit*	-0.001***	-0.009	-0.002*	0.003	0.000
	(-2.97)	(-1.64)	(-1.65)	(0.48)	(0.48)
Δ*Profit*	0.000	0.008	0.002	-0.008	-0.001
	(0.44)	(1.59)	(1.59)	(-1.46)	(-1.46)
Return	0.025***	0.336***	0.062***	-0.462***	-0.077***
	(5.56)	(6.55)	(6.43)	(-8.42)	(-8.28)
Size	-0.005***	-0.069***	-0.013***	0.058***	0.010***
	(-5.06)	(-4.56)	(-4.57)	(3.61)	(3.60)
Quick Ratio	0.004***	0.068***	0.013***	-0.061***	-0.010***

	(3.73)	(4.06)	(4.07)	(-3.49)	(-3.50)
Δ *Lag Quick Ratio*	-0.050***	-0.410***	-0.076***	0.419***	0.069***
	(-12.64)	(-9.38)	(-9.40)	(9.35)	(9.35)
Δ *Quick Ratio*	0.023***	0.138***	0.026***	-0.124***	-0.020***
	(6.61)	(3.62)	(3.63)	(-3.00)	(-3.01)
Leverage	-0.070***	-1.186***	-0.219***	1.087***	0.180***
	(-7.51)	(-9.90)	(-9.97)	(8.94)	(8.98)
Constant	0.031	-0.446	N/A	-0.176	N/A
	(1.34)	(-1.10)		(-0.58)	
Observations	23,634	23,632	23,632	23,632	23,632
Adjusted R^2	0.338	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.001	N/A	0.001	N/A
Correctly Classified	N/A	0.736	N/A	0.768	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To confirm third and fourth hypothesis, we utilize the industry sales median for the last three years as the first metric, and we count dummy industry expansion as 1 if the three lagged medians are larger than zero. We interact CEO overconfidence with industry expansion and monitor the interaction coefficient to assess the influence of overconfident CEOs on company employment during industry expansion. The interaction term of CEO overconfidence and industry expansion has a positive coefficient for net hiring in Column 1-2ii, where we assess employment growth. It indicates that overconfident CEOs have 1.4 percent higher employment growth during an industry expansion and their probability increases by 3.0 percent for growth over 1.0 percent. The findings support Mankiw's (2012) and Ball et al (2013)'s findings that show a positive relationship between economic growth and employment growth. The dependent variable, Emp Reduction, which reflects minus 1.0 percent employment growth, is then regressed to further investigate our fourth hypothesis, showing that overconfident CEOs are 1.9 percent less likely for an employment reduction.

Panel II: Industry Expansion-Contraction (Median of Sales for Last Three Years)

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Industry expansion is a dummy variable which takes the value 1 if industry sales median for last three years were greater than zero. All regressions include year and industry fixed effects

based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1) *Net_Hiring*	(2i) *Emp_Growth_01*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction_01*	(3ii) *Marginal Effects*
OC_GS67	0.010***	0.266***	0.049***	-0.265***	-0.044***
	(2.67)	(4.87)	(4.87)	(-4.63)	(-4.63)
Industry expansion	0.003	0.008	0.001	-0.010	-0.002
	(0.69)	(0.13)	(0.13)	(-0.16)	(-0.16)
*OC_GS67*Industry Expansion*	0.014***	0.161**	0.030**	-0.112	-0.019
	(2.97)	(2.48)	(2.48)	(-1.62)	(-1.62)
Sales Growth	0.433***	4.603***	0.851***	-4.578***	-0.758***
	(24.81)	(17.42)	(20.49)	(-17.24)	(-20.08)
Profit	0.106***	2.641***	0.488***	-3.264***	-0.541***
	(6.26)	(11.42)	(11.71)	(-13.89)	(-14.43)
Δ *Lag Profit*	-0.001***	-0.009	-0.002	0.003	0.000
	(-2.93)	(-1.62)	(-1.62)	(0.46)	(0.46)
Δ*Profit*	0.000	0.008	0.002	-0.008	-0.001
	(0.41)	(1.58)	(1.58)	(-1.45)	(-1.45)
Return	0.025***	0.336***	0.062***	-0.461***	-0.076***
	(5.54)	(6.53)	(6.41)	(-8.40)	(-8.25)
Size	-0.005***	-0.069***	-0.013***	0.058***	0.010***
	(-5.06)	(-4.57)	(-4.57)	(3.61)	(3.61)
Quick Ratio	0.004***	0.068***	0.013***	-0.061***	-0.010***
	(3.75)	(4.06)	(4.07)	(-3.49)	(-3.51)
Δ *Lag Quick Ratio*	-0.050***	-0.411***	-0.076***	0.419***	0.069***
	(-12.67)	(-9.39)	(-9.41)	(9.35)	(9.35)
Δ *Quick Ratio*	0.023***	0.137***	0.025***	-0.123***	-0.020***
	(6.57)	(3.60)	(3.61)	(-2.98)	(-2.99)
Leverage	-0.070***	-1.185***	-0.219***	1.086***	0.180***
	(-7.49)	(-9.91)	(-9.97)	(8.95)	(8.99)
Constant	0.027	-0.469	N/A	-0.156	N/A
	(1.15)	(-1.16)		(-0.51)	
Observations	23,634	23,632	23,632	23,632	23,632
Adjusted R^2	0.339	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.001	N/A	0.001	N/A
Correctly Classified	N/A	0.736	N/A	0.768	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 9 panel III, we utilize rolling lagged cash flow volatility as a second metric to evaluate industry expansion/contraction as a robustness check to our third and fourth hypotheses. Cashflow volatility is computed as the rolling standard deviation of the previous four years' cashflow; that is, the standard deviation of five years' worth of cashflow, where cashflow is calculated as Operating Income Before Depreciation scaled by net assets (total assets minus cash and marketable securities). The coefficient for CEO overconfidence is positive, validating our prediction that an overconfident CEO has a 0.6 percent increase in job growth during a downturn in the industry. Overconfident CEOs are 0.8 percent more likely to have employment growth that exceeds 1.0 percent. Another dependent variable, Emp Reduction, supports our hypothesis by indicating that overconfident CEOs are less likely to reduce company labor by 0.6 percent.

Panel III: Industry Expansion-Contraction (Cashflow Volatility for Lagged 5 Years)

The table presents the results of regression estimates and marginal effects of three measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Cashflow volatility is the rolling standard deviation of lagged 5 years cashflow. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2i)	(2ii)	(3i)	(3ii)
	Net_Hiring	*Emp_Growth_01*	*Marginal Effects*	*Emp_Reduction_01*	*Marginal Effects*
OC_GS67	0.020***	0.343***	0.063***	-0.313***	-0.052***
	(6.46)	(7.87)	(7.86)	(-7.03)	(-7.04)
CF Volatility,	-0.052*	-0.144	-0.027	-0.092	-0.015
	(-1.76)	(-0.44)	(-0.44)	(-0.28)	(-0.28)
OC_GS67 CF Volatility,*	-0.006	0.433	0.080	-0.364	-0.060
	(-0.20)	(1.08)	(1.08)	(-0.83)	(-0.83)
Sales Growth	0.438***	4.608***	0.852***	-4.579***	-0.759***
	(25.32)	(17.45)	(20.56)	(-17.25)	(-20.08)
Profit	0.084***	2.670***	0.494***	-3.363***	-0.557***
	(4.87)	(12.14)	(12.47)	(-14.58)	(-15.04)
Δ *Lag Profit*	-0.001***	-0.009*	-0.002*	0.003	0.000

	(-2.92)	(-1.65)	(-1.65)	(0.51)	(0.51)
Δ*Profit*	0.000	0.008	0.002	-0.008	-0.001
	(0.47)	(1.56)	(1.56)	(-1.44)	(-1.44)
Return	0.025***	0.337***	0.062***	-0.463***	-0.077***
	(5.52)	(6.55)	(6.43)	(-8.45)	(-8.31)
Size	-0.006***	-0.068***	-0.013***	0.054***	0.009***
	(-6.26)	(-4.40)	(-4.40)	(3.33)	(3.33)
Quick Ratio	0.006***	0.066***	0.012***	-0.055***	-0.009***
	(4.70)	(3.88)	(3.90)	(-3.08)	(-3.09)
Δ *Lag Quick Ratio*	-0.048***	-0.413***	-0.076***	0.428***	0.071***
	(-12.14)	(-9.40)	(-9.42)	(9.56)	(9.54)
Δ *Quick Ratio*	0.023***	0.138***	0.025***	-0.123***	-0.020***
	(6.64)	(3.62)	(3.63)	(-2.98)	(-2.98)
Leverage	-0.069***	-1.181***	-0.218***	1.086***	0.180***
	(-7.73)	(-9.84)	(-9.90)	(8.94)	(8.98)
Constant	0.038	-0.440	N/A	-0.160	N/A
	(1.63)	(-1.08)		(-0.53)	
Observations	23,625	23,623	23,623	23,623	23,623
Adjusted R^2	0.339	N/A	N/A	N/A	N/A
Pearson Chi^2	N/A	0.01	N/A	0.001	N/A
Correctly Classified	N/A	0.736	N/A	0.768	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Robustness Check for Overconfidence Measure Using Galasso and Simcoe (2011) With 67% in-the-money

Table 10 panel I depicts the regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) for employment dummies. It shows that overconfident CEOs had a greater rate of job growth and a lower percentage of job termination. When job growth exceeds 5.0, 10, 15 and 20 percent, column 1i, 2i, 3i and 4i represents a dummy 1 and 0 otherwise. Overconfident CEOs show a positive significant relationship with all net hiring dummies, confirming our initial hypothesis that overconfident CEOs have greater employment growth than their peers. CEOs who are overconfident are 9.7, 7.1, 4.6 and 3.0 percent more likely to have a 5.0, 10, 15 and 20 percent or higher rate of employment growth. Higher lagged employment growth, lagged sales growth, change in net profit, change in quick ratio, change in capital expenditure ratio, stock return volatility, and change in Tobin's Q are all associated with this rise. As expected, higher employment is accompanied by a decrease in leverage change.

Panel I: Regression Estimates and Marginal Effects for Net Hiring for Overconfident CEOs

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of five measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Growth_05*	(1ii) *Marginal Effects*	(2i) *Emp_Growth_10*	(2ii) *Marginal Effects*	(3i) *Emp_Growth_15*	(3ii) *Marginal Effects*	(4i) *Emp_Growth_20*	(4ii) *Marginal Effects*
OC_GS67	0.457***	0.097***	0.403***	0.071***	0.325***	0.046***	0.273***	0.030***
	(12.74)	(12.98)	(10.19)	(10.30)	(7.73)	(7.76)	(5.97)	(5.97)

Lag Log (Employees)	-0.199***	-0.042***	-0.252***	-0.045***	-0.277***	-0.039***	-0.293***	-0.033***
	(-14.51)	(-15.05)	(-16.96)	(-17.69)	(-17.66)	(-18.15)	(-17.23)	(-17.50)
Lag Employment Growth	1.011***	0.214***	1.176***	0.208***	1.204***	0.169***	1.283***	0.143***
	(10.45)	(10.54)	(13.02)	(13.17)	(13.76)	(13.88)	(14.08)	(14.22)
Lag Sales Growth	0.904***	0.192***	0.762***	0.135***	0.655***	0.092***	0.564***	0.063***
	(10.24)	(10.40)	(9.61)	(9.70)	(8.97)	(9.02)	(7.71)	(7.72)
Lag RetVol	0.182***	0.039***	0.266***	0.047***	0.373***	0.052***	0.350***	0.039***
	(3.33)	(3.33)	(4.67)	(4.67)	(5.95)	(5.94)	(5.16)	(5.14)
Δ *Lag Profit*	0.014***	0.003***	0.011**	0.002**	0.010**	0.001**	0.007	0.001
	(3.05)	(3.05)	(2.39)	(2.39)	(2.00)	(2.00)	(1.21)	(1.20)
Δ *Lag Leverage*	-0.014**	-0.003**	-0.014**	-0.002**	-0.008	-0.001	-0.012	-0.001
	(-2.24)	(-2.24)	(-1.97)	(-1.98)	(-1.13)	(-1.13)	(-1.39)	(-1.39)
Δ *Lag Quick Ratio*	0.201***	0.043***	0.251***	0.044***	0.266***	0.037***	0.292***	0.033***
	(5.97)	(6.00)	(7.42)	(7.44)	(7.22)	(7.24)	(7.57)	(7.61)
Δ *Lag CAPX Ratio*	0.017	0.004	0.008	0.001	-0.008	-0.001	-0.010	-0.001
	(0.66)	(0.66)	(0.32)	(0.32)	(-0.31)	(-0.31)	(-0.34)	(-0.34)
Δ *Lag Q*	0.698***	0.148***	0.657***	0.116***	0.615***	0.086***	0.634***	0.071***
	(13.40)	(13.62)	(12.54)	(12.67)	(11.56)	(11.62)	(11.07)	(11.10)
Constant	0.257	N/A	0.367	N/A	-0.401	N/A	-1.350	N/A
	(0.56)		(0.64)		(-0.78)		(-1.31)	

Observations	23,663	23,663	23,663	23,663	23,663	23,663	23,652	23,652
Pearson Chi^2	0.062	N/A	0.418	N/A	0.523	N/A	0.363	N/A
Correctly Classified	0.665	N/A	0.742	N/A	0.801	N/A	0.857	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel II backs up our second hypothesis, which states that overconfidence in the CEO leads to a lower drop in employment. If employment growth is less than minus 5.0, 10, 15 and 20 percent, we use a dummy with the value 1 to represent a decline in employment. Overconfident CEOs are 7.8, 4.9, 3.1 and 2.3 percent less likely to experience a negative 5.0, 10, 15 and 20 percent employment growth, according to the findings. Lower lagged employment growth, lagged sales growth, change in net profit, change in Quick ratio, and change in Tobin's Q are all indicators of this possibility. On the other side, it's linked to more leverage change, a larger capital expenditure ratio, and a greater stock return volatility ratio.

Panel II: Regression Estimates and Marginal Effects for Employee Reduction for Overconfident CEOs

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Reduction_05*	(1ii) *Marginal Effects*	(2i) *Emp_Reduction _10*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction _15*	(3ii) *Marginal Effects*	(4i) *Emp_Reduction _20*	(4ii) *Marginal Effects*

OC_GS67	-0.529***	-0.078***	-0.499***	-0.049***	-0.470***	-0.031***	-0.500***	-0.023***
	(-13.19)	(-13.13)	(-10.74)	(-10.57)	(-8.47)	(-8.35)	(-7.38)	(-7.27)
Lag Log (Employees)	0.011	0.002	-0.032*	-0.003*	-0.081***	-0.005***	-0.103***	-0.005***
	(0.70)	(0.70)	(-1.84)	(-1.83)	(-4.05)	(-4.00)	(-4.40)	(-4.32)
Lag Employment Growth	-0.838***	-0.124***	-1.053***	-0.104***	-1.428***	-0.095***	-1.462***	-0.066***
	(-5.73)	(-5.71)	(-5.39)	(-5.35)	(-5.59)	(-5.54)	(-4.54)	(-4.50)
Lag Sales Growth	-1.102***	-0.163***	-1.024***	-0.101***	-0.930***	-0.062***	-0.961***	-0.044***
	(-7.78)	(-7.90)	(-5.94)	(-6.01)	(-4.56)	(-4.59)	(-3.78)	(-3.79)
Lag RetVol	0.020	0.003	0.148*	0.015*	0.232***	0.015***	0.309***	0.014***
	(0.30)	(0.30)	(1.94)	(1.95)	(2.61)	(2.61)	(2.91)	(2.91)
Δ *Lag Profit*	-0.023***	-0.003***	-0.020***	-0.002***	-0.015	-0.001	-0.010	-0.000
	(-3.71)	(-3.72)	(-2.58)	(-2.58)	(-1.63)	(-1.64)	(-0.92)	(-0.92)
Δ *Lag Leverage*	0.014**	0.002**	0.014*	0.001*	0.013	0.001	0.009	0.000
	(2.20)	(2.20)	(1.85)	(1.85)	(1.49)	(1.48)	(0.83)	(0.83)
Δ *Lag Quick Ratio*	-0.225***	-0.033***	-0.256***	-0.025***	-0.343***	-0.023***	-0.392***	-0.018***
	(-4.87)	(-4.88)	(-4.44)	(-4.45)	(-4.68)	(-4.67)	(-4.37)	(-4.37)
Δ *Lag CAPX Ratio*	0.036	0.005	0.040	0.004	0.032	0.002	0.073	0.003
	(1.13)	(1.13)	(1.03)	(1.03)	(0.68)	(0.68)	(1.34)	(1.34)
Δ *Lag Q*	-0.877***	-0.130***	-0.841***	-0.083***	-0.742***	-0.049***	-0.642***	-0.029***
	(-11.33)	(-11.52)	(-8.54)	(-8.63)	(-6.37)	(-6.39)	(-4.66)	(-4.67)
Constant	-1.117***	N/A	-1.379***	N/A	-2.028***	N/A	-3.021***	N/A
	(-3.24)		(-4.45)		(-5.71)		(-3.20)	

Observations	23,663	23,663	23,638	23,638	23,595	23,595	23,578	23,578
Pearson Chi^2	0.001	N/A	0.001	N/A	0.001	N/A	0.001	N/A
Correctly Classified	0.801	N/A	0.879	N/A	0.924	N/A	0.950	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To confirm third and fourth hypothesis, we utilize the industry sales median for the last three years as the first metric, and we count dummy industry expansion as 1 if the three lagged medians are larger than zero. We interact CEO overconfidence with industry expansion and monitor the interaction coefficient to assess the influence of overconfident CEOs on company employment during industry expansion. The interaction term of CEO overconfidence and industry expansion has a positive coefficient for net hiring in panel III, where we assess employment growth. It indicates that overconfident CEOs probability increases by 2.7, 2.0, 2.7 and 1.7 percent for growth over 5.0, 10, 15 and 20 percent. The findings support Mankiw's (2012) and Ball et al (2013)'s findings that show a positive relationship between economic growth and employment growth.

Panel III: Regression Estimates and Marginal Effects for Net Hiring Industry Expansion-Contraction (Median of Sales)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Industry expansion is a dummy variable which takes the value 1 if industry sales median for last three years were greater than zero. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Growth_05*	(1ii) *Marginal Effects*	(2i) *Emp_Growth_10*	(2ii) *Marginal Effects*	(3i) *Emp_Growth_15*	(3ii) *Marginal Effects*	(4i) *Emp_Growth_20*	(4ii) *Marginal Effects*
OC_GS67	0.374***	0.079***	0.326***	0.057***	0.193***	0.027***	0.169**	0.019**

	(6.86)	(6.89)	(5.31)	(5.32)	(2.78)	(2.78)	(2.15)	(2.15)
Industry Expansion	-0.043	-0.009	-0.050	-0.009	-0.089	-0.013	0.038	0.004
	(-0.73)	(-0.73)	(-0.75)	(-0.75)	(-1.18)	(-1.18)	(0.44)	(0.44)
*OC_GS67*Industry Expansion*	0.126**	0.027**	0.115	0.020	0.194**	0.027**	0.148*	0.017*
	(1.98)	(1.98)	(1.63)	(1.63)	(2.41)	(2.41)	(1.66)	(1.66)
Lag Log (Employees)	-0.199***	-0.042***	-0.252***	-0.045***	-0.277***	-0.039***	-0.294***	-0.033***
	(-14.52)	(-15.07)	(-16.97)	(-17.70)	(-17.69)	(-18.18)	(-17.26)	(-17.53)
Lag Employment Growth	1.011***	0.214***	1.176***	0.208***	1.205***	0.169***	1.282***	0.143***
	(10.44)	(10.54)	(13.02)	(13.17)	(13.75)	(13.87)	(14.05)	(14.20)
Lag Sales Growth	0.902***	0.191***	0.761***	0.134***	0.653***	0.092***	0.560***	0.063***
	(10.23)	(10.39)	(9.60)	(9.68)	(8.95)	(8.99)	(7.66)	(7.67)
Lag RetVol	0.180***	0.038***	0.264***	0.047***	0.370***	0.052***	0.345***	0.039***
	(3.29)	(3.29)	(4.63)	(4.63)	(5.88)	(5.87)	(5.09)	(5.07)
Δ *Lag Profit*	0.013***	0.003***	0.011**	0.002**	0.010**	0.001**	0.007	0.001
	(3.04)	(3.04)	(2.38)	(2.38)	(1.99)	(1.98)	(1.19)	(1.19)
Δ *Lag Leverage*	-0.014**	-0.003**	-0.014**	-0.002**	-0.008	-0.001	-0.012	-0.001
	(-2.24)	(-2.24)	(-1.97)	(-1.97)	(-1.12)	(-1.12)	(-1.39)	(-1.39)
Δ *Lag Quick Ratio*	0.200***	0.042***	0.251***	0.044***	0.265***	0.037***	0.291***	0.032***
	(5.95)	(5.98)	(7.40)	(7.42)	(7.20)	(7.21)	(7.53)	(7.57)

Δ *Lag CAPX Ratio*	0.016	0.003	0.007	0.001	-0.009	-0.001	-0.012	-0.001
	(0.63)	(0.63)	(0.30)	(0.30)	(-0.33)	(-0.33)	(-0.39)	(-0.39)
Δ *Lag Q*	0.696***	0.148***	0.656***	0.116***	0.612***	0.086***	0.633***	0.071***
	(13.36)	(13.59)	(12.50)	(12.63)	(11.50)	(11.56)	(11.05)	(11.08)
Constant	0.286	N/A	0.403	N/A	-0.336	N/A	-1.389	N/A
	(0.62)		(0.70)		(-0.65)		(-1.35)	
Observations	23,663	23,663	23,663	23,663	23,663	23,663	23,652	23,652
Pearson Chi^2	0.060	N/A	0.416	N/A	0.521	N/A	0.324	N/A
Correctly Classified	0.666	N/A	0.742	N/A	0.809	N/A	0.857	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The dependent variable, Emp Reduction in panel IV, which reflects less than minus 5.0, 10, 15 and 20 percent employment growth, shows the coefficients and marginal effects positive but insignificant number.

Panel IV: Regression Estimates and Marginal Effects for Employee Reduction Industry Expansion-Contraction (Median of Sales)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Industry expansion is a dummy variable which takes the value 1 if industry sales median for last three years were greater than zero. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Reduction_05*	(1ii) *Marginal Effects*	(2i) *Emp_Reduction _10*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction _15*	(3ii) *Marginal Effects*	(4i) *Emp_Reduction _20*	(4ii) *Marginal Effects*
OC_GS67	-0.551***	-0.081***	-0.586***	-0.058***	-0.519***	-0.035***	-0.577***	-0.026***
	(-8.86)	(-8.86)	(-7.77)	(-7.73)	(-5.50)	(-5.48)	(-4.71)	(-4.68)
Industry Expansion	-0.042	-0.006	-0.030	-0.003	0.109	0.007	0.204	0.009
	(-0.65)	(-0.65)	(-0.38)	(-0.38)	(1.11)	(1.11)	(1.62)	(1.62)
*OC_GS67*Industry Expansion*	0.034	0.005	0.129	0.013	0.069	0.005	0.106	0.005
	(0.45)	(0.45)	(1.42)	(1.42)	(0.61)	(0.61)	(0.74)	(0.74)
Lag Log (Employees)	0.011	0.002	-0.032*	-0.003*	-0.081***	-0.005***	-0.104***	-0.005***
	(0.71)	(0.71)	(-1.84)	(-1.83)	(-4.08)	(-4.03)	(-4.45)	(-4.37)
Lag Employment Growth	-0.838***	-0.124***	-1.054***	-0.104***	-1.433***	-0.095***	-1.471***	-0.067***
	(-5.73)	(-5.70)	(-5.38)	(-5.34)	(-5.59)	(-5.53)	(-4.54)	(-4.50)
Lag Sales Growth	-1.100***	-0.162***	-1.028***	-0.102***	-0.943***	-0.063***	-0.981***	-0.045***
	(-7.77)	(-7.89)	(-5.95)	(-6.02)	(-4.60)	(-4.63)	(-3.83)	(-3.85)
Lag RetVol	0.020	0.003	0.146*	0.014*	0.231***	0.015***	0.308***	0.014***
	(0.30)	(0.30)	(1.92)	(1.92)	(2.61)	(2.61)	(2.91)	(2.90)
Δ *Lag Profit*	-0.023***	-0.003***	-0.020***	-0.002***	-0.015*	-0.001*	-0.010	-0.000
	(-3.71)	(-3.72)	(-2.59)	(-2.60)	(-1.65)	(-1.65)	(-0.94)	(-0.94)
Δ *Lag Leverage*	0.014**	0.002**	0.014*	0.001*	0.013	0.001	0.009	0.000

	(2.20)	(2.20)	(1.85)	(1.85)	(1.49)	(1.48)	(0.84)	(0.84)
Δ *Lag Quick Ratio*	-0.225***	-0.033***	-0.256***	-0.025***	-0.344***	-0.023***	-0.392***	-0.018***
	(-4.87)	(-4.88)	(-4.45)	(-4.45)	(-4.68)	(-4.68)	(-4.37)	(-4.37)
Δ *Lag CAPX Ratio*	0.037	0.005	0.039	0.004	0.029	0.002	0.068	0.003
	(1.13)	(1.13)	(1.00)	(1.00)	(0.61)	(0.61)	(1.24)	(1.24)
Δ *Lag Q*	-0.878***	-0.130***	-0.844***	-0.083***	-0.741***	-0.049***	-0.640***	-0.029***
	(-11.32)	(-11.52)	(-8.55)	(-8.64)	(-6.36)	(-6.38)	(-4.65)	(-4.66)
Constant	-1.082***	N/A	-1.360***	N/A	-2.125***	N/A	-3.199***	N/A
	(-3.09)		(-4.31)		(-5.88)		(-3.35)	
Observations	23,663	23,663	23,638	23,638	23,595	23,595	23,578	23,578
Pearson Chi^2	0.001	N/A	0.001	N/A	0.001	N/A	0.001	N/A
Correctly Classified	0.801	N/A	0.880	N/A	0.924	N/A	0.950	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 10 panel V, we utilize rolling lagged cash flow volatility as a second metric to evaluate industry expansion/contraction as a robustness check to our third and fourth hypotheses. Cashflow volatility is computed as the rolling standard deviation of the previous four years' cashflow; that is, the standard deviation of five years' worth of cashflow, where cashflow is calculated as Operating Income Before Depreciation scaled by net assets (total assets minus cash and marketable securities). The coefficient for interaction of CEO overconfidence and cash flow volatility is positive validating our prediction that an overconfident CEO has job growth during a downturn in the industry.

Panel V: Regression estimates and Marginal Effects for Net Hiring Industry Expansion-Contraction (Cashflow Volatility for Lagged 5 Years)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Cashflow volatility is the rolling standard deviation of past 4 years cashflow. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Growth_05*	(1ii) *Marginal Effects*	(2i) *Emp_Growth_10*	(2ii) *Marginal Effects*	(3i) *Emp_Growth_15*	(3ii) *Marginal Effects*	(4i) *Emp_Growth_20*	(4ii) *Marginal Effects*
OC_GS67	0.449***	0.095***	0.396***	0.070***	0.319***	0.045***	0.269***	0.030***
	(11.12)	(11.27)	(8.95)	(9.02)	(6.76)	(6.78)	(5.22)	(5.22)
CF Volatility,	-0.579***	-0.123***	-0.393**	-0.069**	-0.199	-0.028	-0.248	-0.028
	(-2.99)	(-2.99)	(-1.97)	(-1.97)	(-1.03)	(-1.03)	(-1.28)	(-1.28)
OC_GS67 CF Volatility,*	0.060	0.013	0.037	0.006	0.043	0.006	0.019	0.002
	(0.28)	(0.28)	(0.16)	(0.16)	(0.19)	(0.19)	(0.08)	(0.08)
Lag Log (Employees)	-0.217***	-0.046***	-0.266***	-0.047***	-0.284***	-0.040***	-0.303***	-0.034***
	(-14.72)	(-15.27)	(-16.52)	(-17.20)	(-16.70)	(-17.10)	(-16.70)	(-16.96)
Lag Employment Growth	1.004***	0.213***	1.167***	0.206***	1.199***	0.168***	1.276***	0.142***
	(10.50)	(10.60)	(13.06)	(13.21)	(13.69)	(13.81)	(14.00)	(14.13)
Lag Sales Growth	0.934***	0.198***	0.792***	0.140***	0.671***	0.094***	0.589***	0.066***
	(10.93)	(11.11)	(10.34)	(10.44)	(9.18)	(9.23)	(7.98)	(8.00)
Lag RetVol	0.196***	0.041***	0.275***	0.049***	0.376***	0.053***	0.355***	0.040***
	(3.58)	(3.58)	(4.82)	(4.82)	(6.01)	(6.00)	(5.24)	(5.22)

Δ *Lag Profit*	0.013***	0.003***	0.011**	0.002**	0.010**	0.001**	0.007	0.001
	(2.99)	(2.99)	(2.35)	(2.35)	(1.98)	(1.98)	(1.19)	(1.19)
Δ *Lag Leverage*	-0.014**	-0.003**	-0.013*	-0.002*	-0.008	-0.001	-0.012	-0.001
	(-2.17)	(-2.17)	(-1.94)	(-1.95)	(-1.12)	(-1.12)	(-1.39)	(-1.39)
Δ *Lag Quick Ratio*	0.204***	0.043***	0.253***	0.045***	0.267***	0.037***	0.293***	0.033***
	(6.05)	(6.08)	(7.44)	(7.46)	(7.23)	(7.24)	(7.58)	(7.62)
Δ *Lag CAPX Ratio*	0.019	0.004	0.009	0.002	-0.008	-0.001	-0.010	-0.001
	(0.76)	(0.76)	(0.38)	(0.38)	(-0.30)	(-0.30)	(-0.32)	(-0.32)
Δ *Lag Q*	0.706***	0.149***	0.664***	0.117***	0.617***	0.087***	0.638***	0.071***
	(13.54)	(13.77)	(12.65)	(12.78)	(11.61)	(11.67)	(11.11)	(11.14)
Constant	0.431	N/A	0.491	N/A	-0.338	N/A	-1.265	N/A
	(0.92)		(0.84)		(-0.65)		(-1.23)	
Observations	23,654	23,654	23,654	23,654	23,654	23,654	23,643	23,643
Pearson Chi^2	0.075	N/A	0.383	N/A	0.493	N/A	0.322	N/A
Correctly Classified	0.665	N/A	0.743	N/A	0.801	N/A	0.856	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel VI shows Emp Reduction rate lower than minus 5.0, 10, 15 and 20 percent. Overconfident CEOs are 3.0, 2.7, 1.5 and 0.2 percent less likely to have employment growth that exceeds 5.0, 10, 15 and 20 percent.

Panel VI: Regression Estimates and Marginal Effects for Employee Reduction Industry Expansion-Contraction (Cashflow Volatility for Lagged 5 Years)

The table presents the results of regression estimates (column 1,3,5 and 7) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Cashflow volatility is the rolling standard deviation of past 4 years cashflow. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Reduction_05*	(1ii) *Marginal Effects*	(2i) *Emp_Reduction _10*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction _15*	(3ii) *Marginal Effects*	(4i) *Emp_Reduction _20*	(4ii) *Marginal Effects*
OC_GS67	-0.507***	-0.074***	-0.466***	-0.045***	-0.436***	-0.029***	-0.497***	-0.022***
	(-11.16)	(-11.12)	(-9.01)	(-8.90)	(-7.17)	(-7.10)	(-6.81)	(-6.73)
CF Volatility,	1.676***	0.245***	2.039***	0.199***	2.105***	0.138***	2.025***	0.091***
	(7.46)	(7.49)	(9.10)	(9.14)	(9.92)	(9.90)	(9.80)	(9.67)
OC_GS67 CF Volatility,*	-0.203	-0.030	-0.277	-0.027	-0.223	-0.015	0.049	0.002
	(-0.75)	(-0.75)	(-0.99)	(-0.99)	(-0.83)	(-0.83)	(0.18)	(0.18)
Lag Log (Employees)	0.069***	0.010***	0.048***	0.005***	0.013	0.001	0.004	0.000
	(4.36)	(4.35)	(2.68)	(2.69)	(0.62)	(0.62)	(0.15)	(0.15)
Lag Employment Growth	-0.841***	-0.123***	-1.040***	-0.101***	-1.379***	-0.090***	-1.412***	-0.063***
	(-6.07)	(-6.06)	(-5.81)	(-5.79)	(-5.98)	(-5.93)	(-4.98)	(-4.94)
Lag Sales Growth	-1.107***	-0.162***	-1.024***	-0.100***	-0.927***	-0.061***	-0.927***	-0.041***
	(-8.93)	(-9.05)	(-7.14)	(-7.19)	(-5.70)	(-5.71)	(-4.84)	(-4.82)
Lag RetVol	-0.025	-0.004	0.090	0.009	0.167*	0.011*	0.241**	0.011**
	(-0.37)	(-0.37)	(1.17)	(1.17)	(1.86)	(1.86)	(2.23)	(2.22)

Δ *Lag Profit*	-0.023***	-0.003***	-0.020**	-0.002**	-0.015*	-0.001*	-0.011	-0.000
	(-3.65)	(-3.66)	(-2.54)	(-2.55)	(-1.65)	(-1.65)	(-0.99)	(-0.99)
Δ *Lag Leverage*	0.013*	0.002*	0.011	0.001	0.010	0.001	0.005	0.000
	(1.90)	(1.89)	(1.47)	(1.47)	(1.08)	(1.08)	(0.47)	(0.47)
Δ *Lag Quick Ratio*	-0.239***	-0.035***	-0.275***	-0.027***	-0.361***	-0.024***	-0.407***	-0.018***
	(-5.16)	(-5.18)	(-4.87)	(-4.87)	(-5.01)	(-5.01)	(-4.71)	(-4.71)
Δ *Lag CAPX Ratio*	0.027	0.004	0.027	0.003	0.019	0.001	0.055	0.002
	(0.82)	(0.82)	(0.71)	(0.71)	(0.40)	(0.40)	(1.03)	(1.03)
Δ *Lag Q*	-0.891***	-0.130***	-0.861***	-0.084***	-0.772***	-0.051***	-0.685***	-0.031***
	(-11.90)	(-12.08)	(-9.29)	(-9.36)	(-7.14)	(-7.15)	(-5.37)	(-5.37)
Constant	-1.678***	N/A	-2.132***	N/A	-2.891***	N/A	-3.983***	N/A
	(-4.98)		(-7.03)		(-7.54)		(-3.91)	
Observations	23,654	23,654	23,629	23,629	23,586	23,586	23,569	23,569
Pearson Chi^2	0.001	N/A	0.001	N/A	0.001	N/A	0.001	N/A
Correctly Classified	0.801	N/A	0.879	N/A	0.924	N/A	0.950	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Robustness Check for Overconfidence Measure Using Galasso and Simcoe (2011) With 100% in-the-money

Table 11 panel I depicts the regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) for employment dummies. It shows that overconfident CEOs had a greater rate of job growth and a lower percentage of job termination. When job growth exceeds 5.0, 10, 15 and 20 percent, column 1i, 2i, 3i and 4i represents a dummy 1 and 0 otherwise. Overconfident CEOs show a positive significant relationship with all net hiring dummies, confirming our initial hypothesis that

overconfident CEOs have greater employment growth than their peers. CEOs who are overconfident are 10.0, 7.8, 4.8 and 3.2 percent more likely to have a 5.0, 10, 15 and 20 percent or higher rate of employment growth. Higher lagged employment growth, lagged sales growth, change in net profit, change in quick ratio, change in capital expenditure ratio, stock return volatility, and change in Tobin's Q are all associated with this rise. As expected, higher employment is accompanied by a decrease in leverage change.

Panel I: Regression Estimates and Marginal Effects for Net Hiring for Overconfident CEOs

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Growth_05*	(1ii) *Marginal Effects*	(2i) *Emp_Growth_10*	(2ii) *Marginal Effects*	(3i) *Emp_Growth_15*	(3ii) *Marginal Effects*	(4i) *Emp_Growth_20*	(4ii) *Marginal Effects*
OC_GS100	0.471***	0.100***	0.443***	0.078***	0.342***	0.048***	0.284***	0.032***
	(12.68)	(12.92)	(11.08)	(11.21)	(8.14)	(8.15)	(6.23)	(6.22)
Lag Log (Employees)	-0.192***	-0.041***	-0.247***	-0.043***	-0.272***	-0.038***	-0.290***	-0.032***
	(-14.07)	(-14.56)	(-16.61)	(-17.31)	(-17.42)	(-17.91)	(-17.06)	(-17.33)
Lag Employment Growth	1.013***	0.215***	1.169***	0.206***	1.198***	0.168***	1.278***	0.143***
	(10.47)	(10.56)	(12.94)	(13.09)	(13.69)	(13.82)	(14.02)	(14.16)

Lag Sales Growth	0.890***	0.189***	0.749***	0.132***	0.647***	0.091***	0.559***	0.062***
	(10.13)	(10.29)	(9.49)	(9.57)	(8.88)	(8.93)	(7.62)	(7.63)
Lag RetVol	0.171***	0.036***	0.256***	0.045***	0.365***	0.051***	0.344***	0.038***
	(3.13)	(3.13)	(4.47)	(4.47)	(5.82)	(5.82)	(5.08)	(5.06)
Δ *Lag Profit*	0.014***	0.003***	0.011**	0.002**	0.010**	0.001**	0.007	0.001
	(3.12)	(3.12)	(2.44)	(2.44)	(2.04)	(2.04)	(1.24)	(1.24)
Δ *Lag Leverage*	-0.015**	-0.003**	-0.014**	-0.002**	-0.009	-0.001	-0.012	-0.001
	(-2.29)	(-2.30)	(-2.03)	(-2.03)	(-1.17)	(-1.17)	(-1.42)	(-1.42)
Δ *Lag Quick Ratio*	0.201***	0.043***	0.251***	0.044***	0.266***	0.037***	0.292***	0.033***
	(5.99)	(6.01)	(7.40)	(7.42)	(7.21)	(7.22)	(7.55)	(7.59)
Δ *Lag CAPX Ratio*	0.019	0.004	0.010	0.002	-0.006	-0.001	-0.009	-0.001
	(0.74)	(0.74)	(0.41)	(0.41)	(-0.23)	(-0.23)	(-0.28)	(-0.28)
Δ *Lag Q*	0.698***	0.148***	0.653***	0.115***	0.612***	0.086***	0.631***	0.070***
	(13.41)	(13.64)	(12.49)	(12.62)	(11.53)	(11.59)	(11.04)	(11.08)
Constant	0.206	N/A	0.319	N/A	-0.437	N/A	-1.379	N/A
	(0.45)		(0.55)		(-0.85)		(-1.34)	
Observations	23,663	23,663	23,663	23,663	23,663	23,663	23,652	23,652
Pearson Chi^2	0.070	N/A	0.436	N/A	0.556	N/A	0.447	N/A
Correctly Classified	0.664	N/A	0.743	N/A	0.809	N/A	0.857	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel II backs up our second hypothesis, which states that overconfidence in the CEO leads to a lower drop in employment. If employment growth is less than minus 5.0, 10, 15 and 20 percent, we use a dummy with the value 1 to represent a decline in employment. Overconfident CEOs are 7.7, 4.4, 2.6 and 1.8 percent less likely to experience

a negative 5.0, 10, 15 and 20 percent employment growth, according to the findings. Lower lagged employment growth, lagged sales growth, change in net profit, change in Quick ratio, and change in Tobin's Q are all indicators of this possibility. On the other side, it's linked to more leverage change, a larger capital expenditure ratio, and a greater ratio.

Panel II: Regression Estimates and Marginal Effects for Employee Reduction for Overconfident CEOs

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Reduction_05*	(1ii) *Marginal Effects*	(2i) *Emp_Reduction _10*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction _15*	(3ii) *Marginal Effects*	(4i) *Emp_Reduction _20*	(4ii) *Marginal Effects*
OC_GS100	-0.523***	-0.077***	-0.441***	-0.044***	-0.393***	-0.026***	-0.393***	-0.018***
	(-12.50)	(-12.44)	(-8.85)	(-8.76)	(-6.60)	(-6.54)	(-5.41)	(-5.36)
Lag Log (Employees)	0.004	0.001	-0.037**	-0.004**	-0.085***	-0.006***	-0.107***	-0.005***
	(0.29)	(0.29)	(-2.12)	(-2.11)	(-4.24)	(-4.19)	(-4.57)	(-4.48)
Lag Employment Growth	-0.855***	-0.127***	-1.080***	-0.107***	-1.461***	-0.098***	-1.502***	-0.068***
	(-5.83)	(-5.80)	(-5.50)	(-5.46)	(-5.70)	(-5.65)	(-4.65)	(-4.60)
Lag Sales Growth	-1.094***	-0.162***	-1.025***	-0.102***	-0.935***	-0.062***	-0.969***	-0.044***
	(-7.68)	(-7.79)	(-5.91)	(-5.96)	(-4.57)	(-4.59)	(-3.79)	(-3.80)

Lag RetVol	0.029	0.004	0.149**	0.015**	0.230***	0.015***	0.304***	0.014***
	(0.43)	(0.43)	(1.96)	(1.97)	(2.59)	(2.59)	(2.87)	(2.86)
Δ *Lag Profit*	-0.024***	-0.004***	-0.021***	-0.002***	-0.016*	-0.001*	-0.011	-0.001
	(-3.78)	(-3.79)	(-2.65)	(-2.66)	(-1.71)	(-1.71)	(-1.00)	(-1.00)
Δ *Lag Leverage*	0.015**	0.002**	0.014*	0.001*	0.013	0.001	0.009	0.000
	(2.26)	(2.26)	(1.88)	(1.88)	(1.51)	(1.50)	(0.84)	(0.84)
Δ *Lag Quick Ratio*	-0.226***	-0.033***	-0.258***	-0.026***	-0.346***	-0.023***	-0.397***	-0.018***
	(-4.91)	(-4.92)	(-4.48)	(-4.49)	(-4.72)	(-4.71)	(-4.41)	(-4.41)
Δ *Lag CAPX Ratio*	0.035	0.005	0.039	0.004	0.032	0.002	0.072	0.003
	(1.09)	(1.09)	(1.01)	(1.01)	(0.67)	(0.67)	(1.33)	(1.33)
Δ *Lag Q*	-0.885***	-0.131***	-0.853***	-0.085***	-0.754***	-0.050***	-0.656***	-0.030***
	(-11.40)	(-11.59)	(-8.63)	(-8.72)	(-6.45)	(-6.47)	(-4.74)	(-4.75)
Constant	-1.065***	N/A	-1.341***	N/A	-1.995***	N/A	-2.989***	N/A
	(-3.09)		(-4.29)		(-5.59)		(-3.18)	
Observations	23,663	23,663	23,638	23,638	23,595	23,595	23,578	23,578
Pearson Chi^2	0.001	N/A	0.001	N/A	0.001	N/A	0.001	N/A
Correctly Classified	0.801	N/A	0.879	N/A	0.924	N/A	0.950	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To confirm third and fourth hypothesis, we utilize the industry sales median for the last three years as the first metric, and we count dummy industry expansion as 1 if the three lagged medians are larger than zero. We interact CEO overconfidence with industry expansion and monitor the interaction coefficient to assess the influence of overconfident CEOs on company employment during industry expansion. The interaction term of CEO overconfidence and industry expansion has a positive coefficient for

net hiring in panel III, where we assess employment growth. It indicates that overconfident CEOs probability increases by 4.8, 2.7, 2.8 and 1.8 percent for growth over 5.0, 10, 15 and 20 percent. The findings support Mankiw's (2012) and Ball et al (2013)'s findings that show a positive relationship between economic growth and employment growth.

Panel III: Regression Estimates and Marginal Effects for Net Hiring Industry Expansion-Contraction (Median of Sales)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Industry expansion is a dummy variable which takes the value 1 if industry sales median for last three years were greater than zero. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Growth_05*	(1ii) *Marginal Effects*	(2i) *Emp_Growth_10*	(2ii) *Marginal Effects*	(3i) *Emp_Growth_15*	(3ii) *Marginal Effects*	(4i) *Emp_Growth_20*	(4ii) *Marginal Effects*
OC_GS100	0.353***	0.075***	0.362***	0.064***	0.236***	0.033***	0.196***	0.022***
	(7.70)	(7.75)	(7.32)	(7.35)	(4.41)	(4.41)	(3.28)	(3.27)
Industry Expansion	-0.094*	-0.020*	-0.068	-0.012	-0.089	-0.012	0.034	0.004
	(-1.70)	(-1.70)	(-1.10)	(-1.10)	(-1.27)	(-1.27)	(0.43)	(0.43)
*OC_GS100*Industry Expansion*	0.227***	0.048***	0.153***	0.027***	0.198***	0.028***	0.159**	0.018**
	(4.34)	(4.35)	(2.73)	(2.73)	(3.20)	(3.20)	(2.32)	(2.32)
Lag Log (Employees)	-0.194***	-0.041***	-0.248***	-0.044***	-0.274***	-0.038***	-0.292***	-0.033***

	(-14.21)	(-14.72)	(-16.66)	(-17.38)	(-17.50)	(-18.00)	(-17.13)	(-17.41)
Lag Employment Growth	1.006***	0.213***	1.166***	0.205***	1.197***	0.168***	1.275***	0.142***
	(10.42)	(10.51)	(12.92)	(13.06)	(13.66)	(13.79)	(13.98)	(14.13)
Lag Sales Growth	0.887***	0.188***	0.747***	0.132***	0.645***	0.090***	0.554***	0.062***
	(10.12)	(10.27)	(9.47)	(9.56)	(8.85)	(8.90)	(7.57)	(7.58)
Lag RetVol	0.168***	0.036***	0.254***	0.045***	0.363***	0.051***	0.340***	0.038***
	(3.07)	(3.07)	(4.43)	(4.43)	(5.77)	(5.76)	(5.01)	(4.99)
Δ *Lag Profit*	0.014***	0.003***	0.011**	0.002**	0.010**	0.001**	0.007	0.001
	(3.06)	(3.06)	(2.39)	(2.39)	(1.99)	(1.99)	(1.19)	(1.19)
Δ *Lag Leverage*	-0.015**	-0.003**	-0.014**	-0.002**	-0.008	-0.001	-0.012	-0.001
	(-2.28)	(-2.28)	(-2.01)	(-2.01)	(-1.14)	(-1.14)	(-1.41)	(-1.41)
Δ *Lag Quick Ratio*	0.200***	0.042***	0.250***	0.044***	0.265***	0.037***	0.290***	0.032***
	(5.93)	(5.96)	(7.36)	(7.38)	(7.17)	(7.19)	(7.51)	(7.55)
Δ *Lag CAPX Ratio*	0.017	0.004	0.009	0.002	-0.008	-0.001	-0.011	-0.001
	(0.67)	(0.67)	(0.36)	(0.36)	(-0.28)	(-0.28)	(-0.35)	(-0.35)
Δ *Lag Q*	0.691***	0.146***	0.649***	0.114***	0.607***	0.085***	0.629***	0.070***
	(13.27)	(13.49)	(12.39)	(12.51)	(11.42)	(11.48)	(10.98)	(11.02)
Constant	0.278	N/A	0.372	N/A	-0.367	N/A	-1.410	N/A
	(0.60)		(0.65)		(-0.70)		(-1.36)	

Observations	23,663	23,663	23,663	23,663	23,663	23,663	23,652	23,652
Pearson Chi^2	0.063	N/A	0.423	N/A	0.521	N/A	0.351	N/A
Correctly Classified	0.667	N/A	0.743	N/A	0.809	N/A	0.857	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The dependent variable, Emp Reduction in panel IV, which reflects employment growth lower than minus 5, 10, 15 and 20 percent, is then regressed to further investigate our fourth hypothesis, showing that overconfident CEOs are 3.1, 2.1, 1.7 and 1.4 percent less likely for an employment reduction. All the coefficients are highly significant verifying our hypothesis.

Panel IV: Regression Estimates and Marginal Effects for Employee Reduction Industry Expansion-Contraction (Median of Sales)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Industry expansion is a dummy variable which takes the value 1 if industry sales median for last three years were greater than zero. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Reduction_05*	(1ii) *Marginal Effects*	(2i) *Emp_Reduction _10*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction _15*	(3ii) *Marginal Effects*	(4i) *Emp_Reduction _20*	(4ii) *Marginal Effects*
OC_GS100	-0.412***	-0.061***	-0.328***	-0.032***	-0.248***	-0.017***	-0.224**	-0.010**
	(-8.03)	(-8.02)	(-5.37)	(-5.35)	(-3.31)	(-3.31)	(-2.48)	(-2.48)
Industry Expansion	0.067	0.010	0.117	0.012	0.250***	0.017***	0.376***	0.017***
	(1.06)	(1.06)	(1.56)	(1.56)	(2.65)	(2.65)	(3.11)	(3.11)

*OC_GS100*Industry Expansion*	-0.211***	-0.031***	-0.211***	-0.021***	-0.261***	-0.017***	-0.299***	-0.014***
	(-3.55)	(-3.55)	(-3.07)	(-3.07)	(-3.13)	(-3.12)	(-3.06)	(-3.06)
Lag Log (Employees)	0.006	0.001	-0.036**	-0.004**	-0.084***	-0.006***	-0.106***	-0.005***
	(0.39)	(0.39)	(-2.05)	(-2.04)	(-4.20)	(-4.15)	(-4.55)	(-4.46)
Lag Employment Growth	-0.845***	-0.125***	-1.070***	-0.106***	-1.453***	-0.097***	-1.498***	-0.068***
	(-5.78)	(-5.76)	(-5.46)	(-5.42)	(-5.66)	(-5.61)	(-4.61)	(-4.57)
Lag Sales Growth	-1.087***	-0.161***	-1.023***	-0.101***	-0.942***	-0.063***	-0.982***	-0.045***
	(-7.67)	(-7.78)	(-5.92)	(-5.98)	(-4.60)	(-4.63)	(-3.84)	(-3.85)
Lag RetVol	0.032	0.005	0.153**	0.015**	0.234***	0.016***	0.309***	0.014***
	(0.48)	(0.48)	(2.01)	(2.01)	(2.64)	(2.64)	(2.91)	(2.91)
Δ *Lag Profit*	-0.023***	-0.003***	-0.020***	-0.002***	-0.015*	-0.001*	-0.011	-0.000
	(-3.74)	(-3.75)	(-2.61)	(-2.62)	(-1.67)	(-1.67)	(-0.95)	(-0.95)
Δ *Lag Leverage*	0.015**	0.002**	0.014*	0.001*	0.013	0.001	0.009	0.000
	(2.25)	(2.25)	(1.88)	(1.87)	(1.50)	(1.49)	(0.83)	(0.83)
Δ *Lag Quick Ratio*	-0.225***	-0.033***	-0.257***	-0.025***	-0.345***	-0.023***	-0.395***	-0.018***
	(-4.87)	(-4.88)	(-4.46)	(-4.46)	(-4.70)	(-4.70)	(-4.40)	(-4.39)
Δ *Lag CAPX Ratio*	0.037	0.005	0.040	0.004	0.030	0.002	0.069	0.003
	(1.15)	(1.15)	(1.03)	(1.03)	(0.64)	(0.64)	(1.26)	(1.26)

Δ *Lag Q*	-0.877***	-0.130***	-0.843***	-0.084***	-0.740***	-0.049***	-0.638***	-0.029***
	(-11.29)	(-11.48)	(-8.54)	(-8.63)	(-6.35)	(-6.37)	(-4.64)	(-4.65)
Constant	-1.119***	N/A	-1.441***	N/A	-2.214***	N/A	-3.313***	N/A
	(-3.22)		(-4.51)		(-6.06)		(-3.45)	
Observations	23,663	23,663	23,638	23,638	23,595	23,595	23,578	23,578
Pearson Chi^2	0.001	N/A	0.001	N/A	0.001	N/A	0.001	N/A
Correctly Classified	0.801	N/A	0.880	N/A	0.924	N/A	0.950	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 11 panel V, we utilize rolling lagged cash flow volatility as a second metric to evaluate industry expansion/contraction as a robustness check to our third and fourth hypotheses. Cashflow volatility is computed as the rolling standard deviation of the previous four years' cashflow; that is, the standard deviation of five years' worth of cashflow, where cashflow is calculated as Operating Income Before Depreciation scaled by net assets (total assets minus cash and marketable securities). The coefficient for CEO overconfidence is positive for 20 percent growth, validating our prediction that an overconfident CEO has job growth during a downturn in the industry.

Panel V: Regression Estimates and Marginal Effects for Net Hiring Industry Expansion-Contraction (Cashflow Volatility for Lagged 5 Years)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Cashflow volatility is the rolling standard deviation of past 4 years cashflow. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i)	(1ii)	(2i)	(2ii)	(3i)	(3ii)	(4i)	(4ii)

	Emp_Growth_05	*Marginal Effects*	*Emp_Growth_10*	*Marginal Effects*	*Emp_Growth_15*	*Marginal Effects*	*Emp_Growth_20*	*Marginal Effects*
OC_GS100	0.474***	0.100***	0.443***	0.078***	0.343***	0.048***	0.281***	0.031***
	(11.38)	(11.54)	(9.88)	(9.97)	(7.28)	(7.29)	(5.51)	(5.50)
CF Volatility,	-0.515***	-0.109***	-0.358**	-0.063**	-0.162	-0.023	-0.236	-0.026
	(-2.83)	(-2.83)	(-2.00)	(-2.01)	(-0.96)	(-0.96)	(-1.37)	(-1.37)
OC_GS100 CF Volatility,*	-0.078	-0.017	-0.025	-0.004	-0.020	-0.003	0.003	0.000
	(-0.35)	(-0.35)	(-0.11)	(-0.11)	(-0.09)	(-0.09)	(0.01)	(0.01)
Lag Log (Employees)	-0.211***	-0.045***	-0.260***	-0.046***	-0.280***	-0.039***	-0.300***	-0.033***
	(-14.36)	(-14.86)	(-16.21)	(-16.85)	(-16.48)	(-16.88)	(-16.53)	(-16.79)
Lag Employment Growth	1.005***	0.213***	1.160***	0.204***	1.193***	0.167***	1.271***	0.142***
	(10.51)	(10.62)	(12.97)	(13.12)	(13.63)	(13.75)	(13.94)	(14.06)
Lag Sales Growth	0.921***	0.195***	0.779***	0.137***	0.663***	0.093***	0.583***	0.065***
	(10.83)	(11.00)	(10.20)	(10.30)	(9.08)	(9.13)	(7.88)	(7.90)
Lag RetVol	0.185***	0.039***	0.264***	0.047***	0.369***	0.052***	0.349***	0.039***
	(3.38)	(3.38)	(4.63)	(4.63)	(5.88)	(5.88)	(5.16)	(5.14)
Δ *Lag Profit*	0.014***	0.003***	0.011**	0.002**	0.010**	0.001**	0.007	0.001
	(3.06)	(3.06)	(2.39)	(2.39)	(2.02)	(2.02)	(1.22)	(1.22)
Δ *Lag Leverage*	-0.014**	-0.003**	-0.014**	-0.002**	-0.009	-0.001	-0.012	-0.001
	(-2.24)	(-2.24)	(-2.00)	(-2.00)	(-1.16)	(-1.16)	(-1.41)	(-1.41)
Δ *Lag Quick Ratio*	0.205***	0.043***	0.253***	0.045***	0.267***	0.037***	0.293***	0.033***
	(6.07)	(6.09)	(7.42)	(7.44)	(7.22)	(7.23)	(7.56)	(7.60)

Δ *Lag CAPX Ratio*	0.021	0.005	0.012	0.002	-0.006	-0.001	-0.008	-0.001
	(0.85)	(0.85)	(0.47)	(0.47)	(-0.23)	(-0.23)	(-0.26)	(-0.26)
Δ *Lag Q*	0.706***	0.149***	0.659***	0.116***	0.614***	0.086***	0.636***	0.071***
	(13.57)	(13.80)	(12.61)	(12.73)	(11.59)	(11.65)	(11.08)	(11.11)
Constant	0.376	N/A	0.440	N/A	-0.377	N/A	-1.295	N/A
	(0.80)		(0.75)		(-0.73)		(-1.25)	
Observations	23,654	23,654	23,654	23,654	23,654	23,654	23,643	23,643
Pearson Chi^2	0.088	N/A	0.404	N/A	0.521	N/A	0.401	N/A
Correctly Classified	0.665	N/A	0.743	N/A	0.810	N/A	0.857	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel VI shows Emp Reduction rate lower than minus 5.0, 10, 15 and 20 percent. Half the coefficients are negative, indicating that these CEOs fire less during economic downturn.

Panel VI: Regression Estimates and Marginal Effects for Employee Reduction Industry Expansion-Contraction (Cashflow Volatility for Lagged 5 Years)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence during industry expansion. A CEO is considered overconfident if s/he holds options that are at least 100% in the money. Overconfident CEO is a dummy variable equal to 1 for all years CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. Cashflow volatility is the rolling standard deviation of past 4 years cashflow. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Reduction_05*	(1ii) *Marginal Effects*	(2i) *Emp_Reduction _10*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction _15*	(3ii) *Marginal Effects*	(4i) *Emp_Reduction _20*	(4ii) *Marginal Effects*
OC_GS100	-0.525***	-0.077***	-0.429***	-0.042***	-0.382***	-0.025***	-0.409***	-0.018***
	(-11.15)	(-11.07)	(-7.81)	(-7.72)	(-5.86)	(-5.80)	(-5.20)	(-5.15)
CF Volatility,	1.559***	0.229***	1.935***	0.189***	2.014***	0.132***	1.977***	0.089***
	(7.51)	(7.55)	(9.46)	(9.49)	(10.16)	(10.13)	(10.10)	(9.96)
OC_GS100 CF Volatility,*	0.058	0.009	-0.061	-0.006	-0.017	-0.001	0.199	0.009
	(0.22)	(0.22)	(-0.22)	(-0.22)	(-0.06)	(-0.06)	(0.69)	(0.69)
Lag Log (Employees)	0.062***	0.009***	0.043**	0.004**	0.009	0.001	-0.000	-0.000
	(3.96)	(3.95)	(2.40)	(2.40)	(0.42)	(0.43)	(-0.01)	(-0.01)
Lag Employment Growth	-0.861***	-0.126***	-1.070***	-0.105***	-1.414***	-0.093***	-1.455***	-0.065***
	(-6.18)	(-6.17)	(-5.93)	(-5.91)	(-6.10)	(-6.06)	(-5.09)	(-5.05)
Lag Sales Growth	-1.099***	-0.161***	-1.022***	-0.100***	-0.928***	-0.061***	-0.932***	-0.042***
	(-8.82)	(-8.93)	(-7.11)	(-7.15)	(-5.75)	(-5.76)	(-4.87)	(-4.85)
Lag RetVol	-0.016	-0.002	0.092	0.009	0.166*	0.011*	0.238**	0.011**
	(-0.24)	(-0.24)	(1.20)	(1.20)	(1.85)	(1.85)	(2.20)	(2.19)
Δ *Lag Profit*	-0.023***	-0.003***	-0.021***	-0.002***	-0.016*	-0.001*	-0.012	-0.001
	(-3.74)	(-3.75)	(-2.64)	(-2.64)	(-1.75)	(-1.75)	(-1.07)	(-1.07)
Δ *Lag Leverage*	0.013**	0.002**	0.012	0.001	0.010	0.001	0.006	0.000
	(1.98)	(1.98)	(1.54)	(1.54)	(1.13)	(1.13)	(0.50)	(0.50)

Δ *Lag Quick Ratio*	-0.240***	-0.035***	-0.277***	-0.027***	-0.363***	-0.024***	-0.410***	-0.018***
	(-5.21)	(-5.22)	(-4.91)	(-4.91)	(-5.05)	(-5.05)	(-4.75)	(-4.75)
Δ *Lag CAPX Ratio*	0.025	0.004	0.027	0.003	0.018	0.001	0.054	0.002
	(0.78)	(0.78)	(0.70)	(0.70)	(0.40)	(0.40)	(1.01)	(1.01)
Δ *Lag Q*	-0.899***	-0.132***	-0.872***	-0.085***	-0.785***	-0.052***	-0.701***	-0.031***
	(-11.99)	(-12.17)	(-9.41)	(-9.47)	(-7.25)	(-7.24)	(-5.47)	(-5.47)
Constant	-1.623***	N/A	-2.092***	N/A	-2.858***	N/A	-3.952***	N/A
	(-4.80)		(-6.85)		(-7.44)		(-3.89)	
Observations	23,654	23,654	23,629	23,629	23,586	23,586	23,569	23,569
Pearson Chi^2	0.001	N/A	0.001	N/A	0.001	N/A	0.001	N/A
Correctly Classified	0.801	N/A	0.879	N/A	0.924	N/A	0.950	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Robustness Check for Overconfidence Measure Using Malmendier and Tate (2005) With 67% in-the-money

Table 12 panel I depicts the regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) for employment dummies. It shows that overconfident CEOs had a greater rate of job growth and a lower percentage of job termination. When job growth exceeds 5.0, 10, 15 and 20 percent, column 1i, 2i, 3i and 4i represents a dummy 1 and 0 otherwise. Overconfident CEOs show a positive significant relationship with all net hiring dummies, confirming our initial hypothesis that overconfident CEOs have greater employment growth than their peers. CEOs who are overconfident are 9.5, 6.5, 4.2 and 3.0 percent more likely to have a 5.0, 10, 15 and 20 percent or higher rate of employment growth. Higher lagged employment growth, lagged sales growth, change in net profit, change in quick ratio, change in capital expenditure ratio, stock return volatility, and change in Tobin's Q are all associated with this rise. As expected, higher employment is accompanied by a decrease in leverage change.

Panel I: Regression Estimates and Marginal Effects for Net Hiring for Overconfident CEOs

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Growth_05*	(1ii) *Marginal Effects*	(2i) *Emp_Growth_10*	(2ii) *Marginal Effects*	(3i) *Emp_Growth_15*	(3ii) *Marginal Effects*	(4i) *Emp_Growth_20*	(4ii) *Marginal Effects*
OC_MT67	0.448***	0.095***	0.370***	0.065***	0.301***	0.042***	0.265***	0.030***
	(12.81)	(13.06)	(9.86)	(9.97)	(7.55)	(7.58)	(6.10)	(6.10)
Lag Log (Employees)	-0.201***	-0.043***	-0.255***	-0.045***	-0.280***	-0.039***	-0.296***	-0.033***
	(-14.64)	(-15.20)	(-17.04)	(-17.79)	(-17.74)	(-18.23)	(-17.29)	(-17.56)
Lag Employment Growth	0.991***	0.210***	1.163***	0.206***	1.194***	0.168***	1.274***	0.142***
	(10.24)	(10.32)	(12.86)	(12.99)	(13.64)	(13.75)	(13.97)	(14.10)
Lag Sales Growth	0.914***	0.194***	0.772***	0.136***	0.662***	0.093***	0.569***	0.064***
	(10.33)	(10.51)	(9.71)	(9.80)	(9.07)	(9.12)	(7.77)	(7.79)
Lag RetVol	0.176***	0.037***	0.262***	0.046***	0.369***	0.052***	0.346***	0.039***
	(3.21)	(3.21)	(4.58)	(4.58)	(5.87)	(5.86)	(5.10)	(5.08)

Δ *Lag Profit*	0.013***	0.003***	0.011**	0.002**	0.010**	0.001**	0.007	0.001
	(3.02)	(3.02)	(2.40)	(2.40)	(2.01)	(2.00)	(1.20)	(1.20)
Δ *Lag Leverage*	-0.014**	-0.003**	-0.014**	-0.002**	-0.008	-0.001	-0.012	-0.001
	(-2.24)	(-2.24)	(-1.98)	(-1.98)	(-1.14)	(-1.14)	(-1.41)	(-1.41)
Δ *Lag Quick Ratio*	0.201***	0.043***	0.251***	0.044***	0.266***	0.037***	0.291***	0.033***
	(5.97)	(5.99)	(7.43)	(7.45)	(7.22)	(7.22)	(7.55)	(7.59)
Δ *Lag CAPX Ratio*	0.016	0.003	0.007	0.001	-0.009	-0.001	-0.011	-0.001
	(0.63)	(0.63)	(0.30)	(0.30)	(-0.32)	(-0.32)	(-0.35)	(-0.35)
Δ *Lag Q*	0.715***	0.152***	0.671***	0.119***	0.624***	0.088***	0.640***	0.072***
	(13.73)	(13.97)	(12.81)	(12.94)	(11.76)	(11.83)	(11.22)	(11.25)
Constant	0.316	N/A	0.421	N/A	-0.356	N/A	-1.311	N/A
	(0.69)		(0.73)		(-0.70)		(-1.27)	
Observations	23,663	23,663	23,663	23,663	23,663	23,663	23,652	23,652
Pearson Chi^2	0.053	N/A	0.401	N/A	0.554	N/A	0.431	N/A
Correctly Classified	0.664	N/A	0.741	N/A	0.809	N/A	0.857	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel II backs up our second hypothesis, which states that overconfidence in the CEO leads to a lower drop in employment. If employment growth is less than minus 5.0, 10, 15 and 20 percent, we use a dummy with the value 1 to represent a decline in employment. Overconfident CEOs are 7.5, 4.9, 3.0, 2.2 percent less likely to experience a negative 5.0, 10, 15 and 20 percent employment growth, according to the findings. Lower lagged employment growth, lagged sales growth, stock return volatility, change in net profit, change in Quick ratio, and change in Tobin's Q are all indicators of this possibility. On the other side, it's linked to more leverage change and a larger capital expenditure ratio

Panel II: Regression Estimates and Marginal Effects for Employee Reduction for Overconfident CEOs

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Reduction_05*	(1ii) *Marginal Effects*	(2i) *Emp_Reduction _10*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction _15*	(3ii) *Marginal Effects*	(4i) *Emp_Reduction _20*	(4ii) *Marginal Effects*
OC_MT67	-0.509***	-0.075***	-0.500***	-0.049***	-0.448***	-0.030***	-0.489***	-0.022***
	(-12.53)	(-12.45)	(-10.25)	(-10.09)	(-7.54)	(-7.44)	(-6.77)	(-6.65)
Lag Log (Employees)	0.014	0.002	-0.029	-0.003	-0.077***	-0.005***	-0.099***	-0.005***
	(0.91)	(0.91)	(-1.64)	(-1.64)	(-3.88)	(-3.84)	(-4.25)	(-4.17)
Lag Employment Growth	-0.822***	-0.122***	-1.034***	-0.102***	-1.417***	-0.094***	-1.445***	-0.066***
	(-5.60)	(-5.58)	(-5.29)	(-5.25)	(-5.53)	(-5.48)	(-4.49)	(-4.45)
Lag Sales Growth	-1.119***	-0.166***	-1.040***	-0.103***	-0.950***	-0.063***	-0.983***	-0.045***
	(-7.86)	(-7.98)	(-6.00)	(-6.07)	(-4.62)	(-4.64)	(-3.83)	(-3.84)
Lag RetVol	0.028	0.004	0.157**	0.016**	0.239***	0.016***	0.317***	0.014***
	(0.42)	(0.42)	(2.08)	(2.08)	(2.71)	(2.71)	(3.02)	(3.01)

Δ *Lag Profit*	-0.023***	-0.003***	-0.020***	-0.002***	-0.015*	-0.001*	-0.010	-0.000
	(-3.71)	(-3.72)	(-2.58)	(-2.59)	(-1.64)	(-1.65)	(-0.93)	(-0.93)
Δ *Lag Leverage*	0.014**	0.002**	0.014*	0.001*	0.013	0.001	0.009	0.000
	(2.17)	(2.17)	(1.84)	(1.84)	(1.48)	(1.48)	(0.83)	(0.83)
Δ *Lag Quick Ratio*	-0.226***	-0.033***	-0.257***	-0.025***	-0.345***	-0.023***	-0.394***	-0.018***
	(-4.89)	(-4.90)	(-4.46)	(-4.46)	(-4.68)	(-4.68)	(-4.36)	(-4.35)
Δ *Lag CAPX Ratio*	0.038	0.006	0.042	0.004	0.034	0.002	0.076	0.003
	(1.17)	(1.17)	(1.07)	(1.07)	(0.73)	(0.72)	(1.39)	(1.39)
Δ *Lag Q*	-0.904***	-0.134***	-0.866***	-0.086***	-0.765***	-0.051***	-0.665***	-0.030***
	(-11.63)	(-11.83)	(-8.75)	(-8.84)	(-6.53)	(-6.56)	(-4.80)	(-4.81)
Constant	-1.184***	N/A	-1.442***	N/A	-2.085***	N/A	-3.080***	N/A
	(-3.44)		(-4.62)		(-5.88)		(-3.25)	
Observations	23,663	23,663	23,638	23,638	23,595	23,595	23,578	23,578
Pearson Chi^2	0.001	N/A	0.001	N/A	0.001	N/A	0.001	N/A
Correctly Classified	0.801	N/A	0.879	N/A	0.924	N/A	0.950	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To confirm third and fourth hypothesis, we utilize the industry sales median for the last three years as the first metric, and we count dummy industry expansion as 1 if the three lagged medians are larger than zero. We interact CEO overconfidence with industry expansion and monitor the interaction coefficient to assess the influence of overconfident CEOs on company employment during industry expansion. The interaction term of CEO overconfidence and industry expansion has a positive coefficient for net hiring in panel III, where we assess employment growth. It indicates that overconfident CEOs probability increases by 5.4, 4.5,3.6 and 2.1 percent for growth over 5.0, 10 and 15 percent. The findings support Mankiw's (2012) and Ball et al (2013)'s findings that show a positive relationship between economic growth and employment growth.

Panel III: Regression Estimates and Marginal Effects for Net Hiring Industry Expansion-Contraction (Median of Sales)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Growth_05*	(1ii) *Marginal Effects*	(2i) *Emp_Growth_10*	(2ii) *Marginal Effects*	(3i) *Emp_Growth_15*	(3ii) *Marginal Effects*	(4i) *Emp_Growth_20*	(4ii) *Marginal Effects*
OC_MT67	0.318***	0.067***	0.239***	0.042***	0.169***	0.024***	0.164***	0.018***
	(7.54)	(7.59)	(5.27)	(5.29)	(3.48)	(3.48)	(3.07)	(3.08)
Industry Expansion	-0.116**	-0.024**	-0.133**	-0.023**	-0.128*	-0.018*	0.010	0.001
	(-2.11)	(-2.11)	(-2.17)	(-2.17)	(-1.85)	(-1.85)	(0.14)	(0.14)
*OC_MT67*Industry Expansion*	0.254***	0.054***	0.254***	0.045***	0.256***	0.036***	0.191***	0.021***
	(4.96)	(4.97)	(4.57)	(4.58)	(4.29)	(4.29)	(2.97)	(2.97)
Lag Log (Employees)	-0.201***	-0.043***	-0.255***	-0.045***	-0.279***	-0.039***	-0.296***	-0.033***
	(-14.62)	(-15.18)	(-17.01)	(-17.76)	(-17.68)	(-18.19)	(-17.25)	(-17.53)
Lag Employment Growth	0.991***	0.210***	1.164***	0.205***	1.196***	0.168***	1.273***	0.142***
	(10.24)	(10.33)	(12.86)	(13.00)	(13.62)	(13.74)	(13.93)	(14.07)

Lag Sales Growth	0.905***	0.192***	0.764***	0.135***	0.654***	0.092***	0.560***	0.063***
	(10.27)	(10.43)	(9.63)	(9.72)	(8.96)	(9.01)	(7.66)	(7.68)
Lag RetVol	0.171***	0.036***	0.258***	0.046***	0.365***	0.051***	0.341***	0.038***
	(3.13)	(3.13)	(4.51)	(4.51)	(5.80)	(5.79)	(5.02)	(5.00)
Δ *Lag Profit*	0.013***	0.003***	0.011**	0.002**	0.010**	0.001**	0.006	0.001
	(2.99)	(2.99)	(2.36)	(2.36)	(1.96)	(1.96)	(1.16)	(1.16)
Δ *Lag Leverage*	-0.014**	-0.003**	-0.014**	-0.002**	-0.008	-0.001	-0.012	-0.001
	(-2.24)	(-2.24)	(-1.96)	(-1.96)	(-1.12)	(-1.12)	(-1.39)	(-1.40)
Δ *Lag Quick Ratio*	0.199***	0.042***	0.250***	0.044***	0.264***	0.037***	0.290***	0.032***
	(5.91)	(5.94)	(7.38)	(7.39)	(7.17)	(7.18)	(7.51)	(7.55)
Δ *Lag CAPX Ratio*	0.015	0.003	0.007	0.001	-0.009	-0.001	-0.012	-0.001
	(0.58)	(0.58)	(0.27)	(0.27)	(-0.34)	(-0.34)	(-0.40)	(-0.40)
Δ *Lag Q*	0.703***	0.149***	0.660***	0.116***	0.614***	0.086***	0.634***	0.071***
	(13.50)	(13.73)	(12.58)	(12.70)	(11.54)	(11.60)	(11.08)	(11.11)
Constant	0.376	N/A	0.496	N/A	-0.285	N/A	-1.346	N/A
	(0.81)		(0.86)		(-0.55)		(-1.30)	
Observations	23,663	23,663	23,663	23,663	23,663	23,663	23,652	23,652
Pearson Chi^2	0.050	N/A	0.388	N/A	0.505	N/A	0.328	N/A
Correctly Classified	0.663	N/A	0.74	N/A	0.809	N/A	0.857	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The dependent variable, Emp Reduction in panel IV, which reflects minus 5.0, 10, 15 and 20 percent employment growth, is then regressed to further investigate our fourth hypothesis, showing that overconfident CEOs are 3.3, 1.4, 1.3 and 0.9 percent less likely for an employment reduction.

Panel IV: Regression estimates and Marginal Effects for Employee Reduction Industry expansion-contraction (median of Sales)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Reduction_05*	(1ii) *Marginal Effects*	(2i) *Emp_Reduction _10*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction _15*	(3ii) *Marginal Effects*	(4i) *Emp_Reduction _20*	(4ii) *Marginal Effects*
OC_MT67	-0.395***	-0.058***	-0.425***	-0.042***	-0.342***	-0.023***	-0.386***	-0.018***
	(-8.05)	(-8.03)	(-7.15)	(-7.11)	(-4.75)	(-4.73)	(-4.43)	(-4.38)
Industry Expansion	0.077	0.011	0.091	0.009	0.226**	0.015**	0.330***	0.015***
	(1.22)	(1.22)	(1.23)	(1.23)	(2.41)	(2.41)	(2.75)	(2.75)
*OC_MT67*Industry Expansion*	-0.221***	-0.033***	-0.143**	-0.014**	-0.198**	-0.013**	-0.191**	-0.009**
	(-3.76)	(-3.76)	(-2.09)	(-2.09)	(-2.47)	(-2.46)	(-2.00)	(-2.00)
Lag Log (Employees)	0.013	0.002	-0.030*	-0.003*	-0.079***	-0.005***	-0.101***	-0.005***

	(0.85)	(0.85)	(-1.68)	(-1.68)	(-3.96)	(-3.92)	(-4.34)	(-4.27)
Lag Employment Growth	-0.820***	-0.121***	-1.033***	-0.102***	-1.420***	-0.095***	-1.453***	-0.066***
	(-5.61)	(-5.59)	(-5.29)	(-5.26)	(-5.53)	(-5.48)	(-4.50)	(-4.46)
Lag Sales Growth	-1.107***	-0.164***	-1.036***	-0.102***	-0.952***	-0.063***	-0.992***	-0.045***
	(-7.81)	(-7.93)	(-5.99)	(-6.05)	(-4.64)	(-4.66)	(-3.86)	(-3.88)
Lag RetVol	0.031	0.005	0.159**	0.016**	0.241***	0.016***	0.319***	0.014***
	(0.47)	(0.47)	(2.10)	(2.10)	(2.74)	(2.74)	(3.03)	(3.03)
Δ *Lag Profit*	-0.023***	-0.003***	-0.020**	-0.002**	-0.015	-0.001	-0.010	-0.000
	(-3.68)	(-3.69)	(-2.57)	(-2.57)	(-1.63)	(-1.63)	(-0.92)	(-0.92)
Δ *Lag Leverage*	0.014**	0.002**	0.014*	0.001*	0.013	0.001	0.009	0.000
	(2.18)	(2.18)	(1.85)	(1.85)	(1.48)	(1.48)	(0.84)	(0.84)
Δ *Lag Quick Ratio*	-0.225***	-0.033***	-0.256***	-0.025***	-0.344***	-0.023***	-0.393***	-0.018***
	(-4.85)	(-4.86)	(-4.44)	(-4.45)	(-4.67)	(-4.67)	(-4.36)	(-4.35)
Δ *Lag CAPX Ratio*	0.039	0.006	0.042	0.004	0.031	0.002	0.071	0.003
	(1.21)	(1.21)	(1.07)	(1.06)	(0.66)	(0.66)	(1.30)	(1.30)
Δ *Lag Q*	-0.890***	-0.132***	-0.856***	-0.085***	-0.750***	-0.050***	-0.648***	-0.029***
	(-11.45)	(-11.65)	(-8.64)	(-8.73)	(-6.41)	(-6.43)	(-4.69)	(-4.70)
Constant	-1.216***	N/A	-1.500***	N/A	-2.253***	N/A	-3.336***	N/A
	(-3.51)		(-4.71)		(-6.22)		(-3.47)	

Observations	23,663	23,663	23,638	23,638	23,595	23,595	23,578	23,578
Pearson Chi^2	0.001	N/A	0.001	N/A	0.001	N/A	0.001	N/A
Correctly Classified	0.801	N/A	0.880	N/A	0.924	N/A	0.950	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In table 12 panel V, we utilize rolling lagged cash flow volatility as a second metric to evaluate industry expansion/contraction as a robustness check to our third and fourth hypotheses. Cashflow volatility is computed as the rolling standard deviation of the previous four years' cashflow; that is, the standard deviation of five years' worth of cashflow, where cashflow is calculated as Operating Income Before Depreciation scaled by net assets (total assets minus cash and marketable securities. Most interaction coefficients are positive indicating that Overconfident CEOs are more likely to have employment growth that exceeds 5.0, 10, 15 and 20 percent.

Panel V: Regression Estimates and Marginal Effects for Net Hiring Industry Expansion-Contraction (Cashflow Volatility for Lagged 5 Years)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Growth_05*	(1ii) *Marginal Effects*	(2i) *Emp_Growth_10*	(2ii) *Marginal Effects*	(3i) *Emp_Growth_15*	(3ii) *Marginal Effects*	(4i) *Emp_Growth_20*	(4ii) *Marginal Effects*
OC_MT67	0.453***	0.096***	0.364***	0.064***	0.283***	0.040***	0.252***	0.028***
	(11.62)	(11.80)	(8.65)	(8.72)	(6.34)	(6.37)	(5.19)	(5.19)
CF Volatility,	-0.513***	-0.109***	-0.398**	-0.070**	-0.259	-0.036	-0.292*	-0.033*

	(-3.03)	(-3.03)	(-2.37)	(-2.37)	(-1.64)	(-1.64)	(-1.71)	(-1.71)
OC_MT67 CF Volatility,*	-0.104	-0.022	0.045	0.008	0.184	0.026	0.118	0.013
	(-0.48)	(-0.48)	(0.20)	(0.20)	(0.85)	(0.85)	(0.50)	(0.50)
Lag Log (Employees)	-0.220***	-0.047***	-0.269***	-0.047***	-0.287***	-0.040***	-0.307***	-0.034***
	(-14.89)	(-15.47)	(-16.62)	(-17.30)	(-16.79)	(-17.19)	(-16.78)	(-17.04)
Lag Employment Growth	0.986***	0.209***	1.154***	0.204***	1.187***	0.167***	1.265***	0.141***
	(10.30)	(10.39)	(12.89)	(13.03)	(13.56)	(13.66)	(13.88)	(13.99)
Lag Sales Growth	0.943***	0.200***	0.802***	0.142***	0.680***	0.095***	0.594***	0.066***
	(11.01)	(11.20)	(10.43)	(10.54)	(9.29)	(9.34)	(8.05)	(8.07)
Lag RetVol	0.189***	0.040***	0.271***	0.048***	0.373***	0.052***	0.351***	0.039***
	(3.46)	(3.46)	(4.74)	(4.74)	(5.94)	(5.93)	(5.17)	(5.15)
Δ *Lag Profit*	0.013***	0.003***	0.011**	0.002**	0.010**	0.001**	0.007	0.001
	(2.97)	(2.97)	(2.36)	(2.36)	(1.98)	(1.98)	(1.18)	(1.18)
Δ *Lag Leverage*	-0.014**	-0.003**	-0.013*	-0.002*	-0.008	-0.001	-0.012	-0.001
	(-2.19)	(-2.19)	(-1.95)	(-1.95)	(-1.12)	(-1.12)	(-1.39)	(-1.39)
Δ *Lag Quick Ratio*	0.204***	0.043***	0.253***	0.045***	0.267***	0.037***	0.293***	0.033***
	(6.05)	(6.07)	(7.45)	(7.47)	(7.21)	(7.22)	(7.56)	(7.60)
Δ *Lag CAPX Ratio*	0.019	0.004	0.009	0.002	-0.009	-0.001	-0.010	-0.001
	(0.75)	(0.75)	(0.36)	(0.36)	(-0.32)	(-0.32)	(-0.33)	(-0.33)
Δ *Lag Q*	0.722***	0.153***	0.677***	0.120***	0.627***	0.088***	0.645***	0.072***

	(13.88)	(14.13)	(12.92)	(13.06)	(11.81)	(11.88)	(11.25)	(11.28)
Constant	0.487	N/A	0.547	N/A	-0.288	N/A	-1.222	N/A
	(1.04)		(0.93)		(-0.56)		(-1.18)	
Observations	23,654	23,654	23,654	23,654	23,654	23,654	23,643	23,643
Pearson Chi^2	0.072	N/A	0.369	N/A	0.531	N/A	0.393	N/A
Correctly Classified	0.665	N/A	0.741	N/A	0.809	N/A	0.857	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel VI shows Emp Reduction rate lower than minus 5.0, 10, 15 and 20 percent. Most interaction coefficients are negative indicating that Overconfident CEOs are less likely to have employment growth that exceeds 5.0, 10, 15 and 20 percent.

Panel VI: Regression Estimates and Marginal Effects for Employee Reduction Industry Expansion-Contraction (Cashflow Volatility for Lagged 5 Years)

The table presents the results of regression estimates (column 1i, 2i, 3i and 4i) and average marginal effects (column 1ii, 2ii, 3ii and 4ii) of measures of employment growth on CEO overconfidence. A CEO is considered overconfident if s/he holds options that are at least 67% in the money. Overconfident CEO is a dummy variable equal to 1 for all years after the first time a CEO displays overconfidence if he displayed overconfidence at least twice during the tenure. All regressions include year and industry fixed effects based on three-digit SIC codes. Standard errors are clustered for observations at the firm level (t-statistics are in parentheses). *, **, and *** measure significance at the 10%, 5%, and 1% level, respectively.

	(1i) *Emp_Reduction_05*	(1ii) *Marginal Effects*	(2i) *Emp_Reduction _10*	(2ii) *Marginal Effects*	(3i) *Emp_Reduction _15*	(3ii) *Marginal Effects*	(4i) *Emp_Reduction _20*	(4ii) *Marginal Effects*

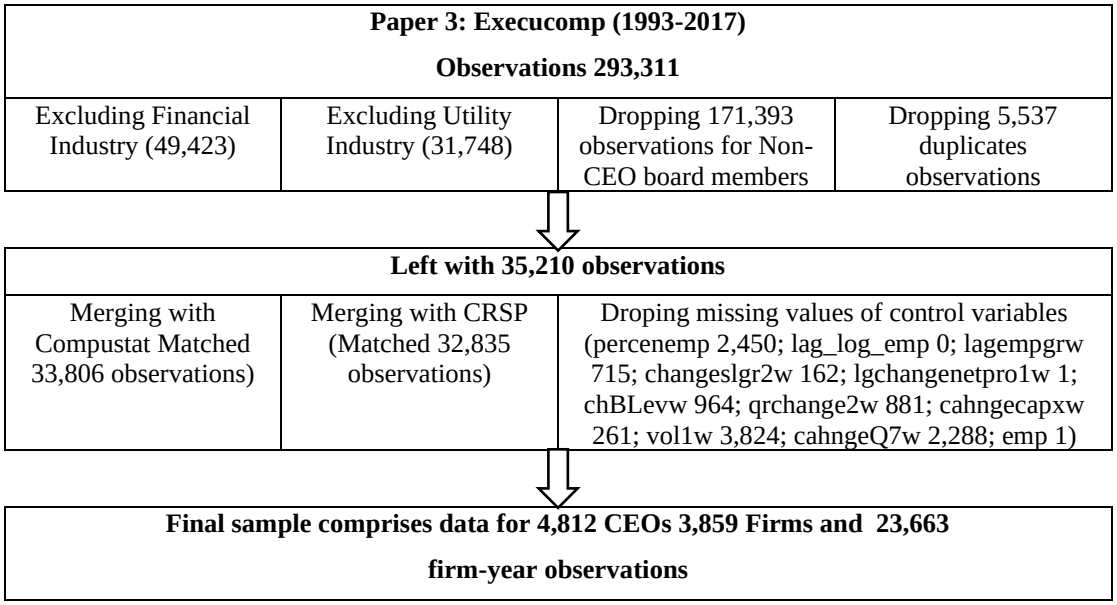
OC_MT67	-0.504***	-0.074***	-0.491***	-0.048***	-0.439***	-0.029***	-0.520***	-0.023***
	(-11.12)	(-11.05)	(-9.23)	(-9.10)	(-6.81)	(-6.75)	(-6.75)	(-6.65)
CF Volatility,	1.599***	0.234***	1.942***	0.190***	2.025***	0.133***	1.961***	0.088***
	(8.06)	(8.10)	(9.82)	(9.85)	(10.77)	(10.71)	(10.37)	(10.19)
OC_MT67 CF Volatility,*	-0.024	-0.004	-0.060	-0.006	-0.028	-0.002	0.284	0.013
	(-0.09)	(-0.09)	(-0.21)	(-0.21)	(-0.10)	(-0.10)	(0.99)	(0.99)
Lag Log (Employees)	0.072***	0.011***	0.051***	0.005***	0.016	0.001	0.007	0.000
	(4.58)	(4.57)	(2.90)	(2.90)	(0.80)	(0.80)	(0.31)	(0.31)
Lag Employment Growth	-0.827***	-0.121***	-1.024***	-0.100***	-1.371***	-0.090***	-1.406***	-0.063***
	(-5.94)	(-5.93)	(-5.71)	(-5.68)	(-5.90)	(-5.85)	(-4.94)	(-4.90)
Lag Sales Growth	-1.123***	-0.165***	-1.038***	-0.101***	-0.942***	-0.062***	-0.940***	-0.042***
	(-9.00)	(-9.12)	(-7.21)	(-7.26)	(-5.76)	(-5.76)	(-4.88)	(-4.86)
Lag RetVol	-0.017	-0.003	0.100	0.010	0.175*	0.011*	0.251**	0.011**
	(-0.26)	(-0.26)	(1.30)	(1.30)	(1.96)	(1.96)	(2.34)	(2.33)
Δ *Lag Profit*	-0.023***	-0.003***	-0.020**	-0.002**	-0.015*	-0.001*	-0.011	-0.000
	(-3.66)	(-3.67)	(-2.56)	(-2.56)	(-1.67)	(-1.68)	(-1.01)	(-1.01)
Δ *Lag Leverage*	0.013*	0.002*	0.012	0.001	0.010	0.001	0.006	0.000
	(1.90)	(1.90)	(1.51)	(1.51)	(1.11)	(1.11)	(0.50)	(0.50)
Δ *Lag Quick Ratio*	-0.241***	-0.035***	-0.277***	-0.027***	-0.362***	-0.024***	-0.408***	-0.018***
	(-5.20)	(-5.21)	(-4.89)	(-4.90)	(-5.02)	(-5.02)	(-4.71)	(-4.71)
Δ *Lag CAPX Ratio*	0.028	0.004	0.029	0.003	0.020	0.001	0.056	0.002
	(0.86)	(0.86)	(0.75)	(0.75)	(0.44)	(0.44)	(1.05)	(1.04)

Δ *Lag Q*	-0.917***	-0.134***	-0.886***	-0.086***	-0.795***	-0.052***	-0.709***	-0.032***
	(-12.21)	(-12.40)	(-9.52)	(-9.59)	(-7.33)	(-7.33)	(-5.53)	(-5.52)
Constant	-1.747***	N/A	-2.197***	N/A	-2.951***	N/A	-4.044***	N/A
	(-5.18)		(-7.16)		(-7.71)		(-3.95)	
Observations	23,654	23,654	23,629	23,629	23,586	23,586	23,569	23,569
Pearson Chi^2	0.001	N/A	0.001	N/A	0.001	N/A	0.001	N/A
Correctly Classified	0.801	N/A	0.880	N/A	0.924	N/A	0.950	N/A

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

9. Appendix

9.1. Appendix III (A): Data Filtering Process



9.2. Appendix III (B): Variable Definition

Employment decision variables	
Net Hiring	Change in the number of employees between year t-1 and year t.
Emp_Growth_01	Indicator variable that takes a value of 1 if *Net_Hiring* is greater than 1%.
Emp_Growth_5	Indicator variable that takes a value of 1 if *Net_Hiring* is greater than 5%.
Emp_Growth_10	Indicator variable that takes a value of 1 if *Net_Hiring* is greater than 10%.
Emp_Growth_15	Indicator variable that takes a value of 1 if *Net_Hiring* is greater than 15%.
Emp_Growth_20	Indicator variable that takes a value of 1 if *Net_Hiring* is greater than 20%.
Emp_Reduction_01	Indicator variable that takes a value of 1 if *Net_Hiring* is smaller than -1%.
Emp_Reduction_05	Indicator variable that takes a value of 1 if *Net_Hiring* is smaller than -5%.
Emp_Reduction_10	Indicator variable that takes a value of 1 if *Net_Hiring* is smaller than -10%.
Emp_Reduction_15	Indicator variable that takes a value of 1 if *Net_Hiring* is smaller than -15%.
Emp_Reduction_20	Indicator variable that takes a value of 1 if *Net_Hiring* is smaller than -20%.
CEO overconfidence variables	
OC_GS67	Indicator variable that takes a value of 1 for all CEO-years if the CEO postpones the exercise of vested options that are at least 67% in the money at least twice during the tenure, in any two years, or 0 otherwise.
OC_MT67	Indicator variable that takes a value of 1 if a CEO postpones the exercise of vested options that are at least 67% in the money at least twice during the tenure, in any two years, or 0 otherwise.
OC_GS100	Indicator variable that takes a value of 1 for all CEO-years if the CEO postpones the exercise of vested options that are at least 100% in the money at least twice during the tenure, in any two years, and 0 otherwise.
Control variables	
Lag Log (Employees)	Natural logarithm of number of employees multiplied by 1000 in year t-1
Lag Employment Growth	Change in in the number of employees between year t-2 and year t-1.
Lag Sales Growth	Change in sales revenue in year t-2 and in year t-1.
Lag RetVol	Stock return volatility in year t-1 (i.e., from t-2 to t-1), where return volatility is measured as standard deviation of weekly stock return within a year

Δ ***Profit***	Change in net income scaled by beginning-of-year total assets from t-1 to t
Δ ***Lag Profit***	Change in net income scaled by beginning-of-year total assets from t-2 to t-1
Δ ***Lag Leverage***	Change in ratio of long-term debt plus debt in current liabilities, scaled by beginning-of-year book value of assets in year t-1(ie, change from t-2 to t-1)
Δ ***Quick Ratio***	The ratio of cash and short-term investments plus receivables to current liabilities in year t (i.e., change from t-1 to t)
Δ ***Lag Quick Ratio***	The ratio of cash and short-term investments plus receivables to current liabilities in year t-1 (i.e., change from t-2 to t-1)
Δ ***Lag Capex/Assets***	Ratio of capital expenditure to beginning-of-year book value of assets in year t-1 (i.e., from t-2 to t-1)
Δ ***Lag Q***	Change in Tobin's Q in year t-1 (ie, from t-2 to t-1)

c. Conclusions

The objective of the thesis is to uncover the relation between managerial overconfidence, corporate strategic decisions and corporate governance structure. The thesis is divided into three papers where we analyse CEO overconfidence with regards to R&D expenditure, board structure and firm's HR policy. We use multiple measure for CEO overconfidence Galasso and Simcoe (2011) and Malmendier and Tate (2005) at 67% and 100% in-the money) and use several sets of controls to verify the robustness of our findings.

Our findings show a number of novel links between CEO overconfidence and a range of corporate initiatives. Our first paper presents the most updated research on the evolving relationship between CEO overconfidence and innovation. Ours is one of the first studies to look at business innovation in both the pre- and post-crisis periods, and to find increased board dominance in the post-crisis era which diminishes the positive link between CEO overconfidence and R&D investment. We contribute to the knowledge on the practical implications of financial crises, especially the empirical research on crises and growth. Our second paper, based on the conclusion of the first, examines in further depth the internal and external determinants of corporate governance mechanism for overconfident CEOs. We find significant distinct characteristics of board structure between firms lead by overconfident and non-overconfident CEOs. Overconfident CEOs, we conclude, prefer to have familiar, less crowded and more controlling power over the board of directors. These empirical findings allow us to explain the non-conventional behaviour of overconfident CEOs and find corporate governance as a catalyst to influence the behaviour. Our third paper adds to the growing body of knowledge about the interaction of HR policies in the presence of overconfident CEOs. When employing various hiring and firing criteria, we show that overconfident CEOs are more likely to have positive employment growth and negative employment reduction, both in industry expansion and contraction. Our findings here are linked back to second paper, as we find in smaller and financially strapped firms, CEO overconfidence has a much greater impact. We argue that the greater corporate governance scrutiny of larger organizations dominates the CEO and limits their ability to implement decisions. Despite the increased scrutiny,

overconfident CEOs had stronger employment growth in firms than non-overconfident CEOs, revealing that, regardless of their decreased dominance, overconfident CEOs still have a positive influence on firm employment growth.

The implications of these findings are significant for corporate policy and organizational design. Standard incentives like stock and option-based compensation, for example, are unlikely to alleviate the negative impacts of managerial overconfidence. Business critics frequently cite examples of overconfident CEOs who have made terrible moves. The possibility of a major defeat, on the other hand, may be a corollary of the chance of a major triumph, therefore the conclusion from examples is unclear. This dark side of CEO overconfidence may appear to imply that the CEO selection process should be structured to screen out egotistical CEOs, or that compensation and governance should be geared to severely limit such CEOs. Our findings also point out that the board of directors may need to use different disciplinary actions to rein in overconfident CEOs, such as debt overhang. Furthermore, the findings support the need for directors who are both independent and active.

Our findings provide some possible explanations for why so many firms hire overconfident CEOs (Malmendier and Tate, 2005a, 2008; Ben-David, Graham, and Harvey, 2010), and why such CEOs appear to be placed at the helm of growth firms (Graham, Harvey, and Puri, 2010) - the type of firm where overconfidence will have the most impact. Overconfident CEOs also have positive influence such as improving decision implementation (Russo and Schoemaker, 1992), encouraging agents to take sufficient risk on behalf of principals (Goel and Thakor, 2008; Gervais, Heaton, and Odean, 2011), or countering in formation externality problems by stimulating entrepreneurship and experimentation (Bernardo and Welch, 2001). "Unbridled confidence arrogance," according to Vinod Khosla, co-founder of Sun Microsystems Inc. and venture capitalist, is a crucial attribute of great business visionaries. Our research shows that there is a beneficial side to CEO overconfidence, and as suggested above, with some planned changes, these CEOs could be highly beneficial for firms, irrespective of their form.

Like almost every empirical research, our analysis is limited to data sources provided by the institution. To capture CEO overconfidence, there are other measures

like the financial press-based measure, which classifies a CEO as overconfident if the number of press articles in leading business publications describing the manager as "confident/optimistic," or similar words, exceeds the number of articles describing the manager as "pessimistic/cautious," or similar words (Malmendier and Tate, 2008; Hirshleifer et al., 2012). Considering the fact that this is not a market-based measure, it is a "necessarily noisy and less precise measure" (Malmendier and Tate, 2008) specifically, comments may lack objectivity due to media bias or perceptional biases associated with the author of the article portraying the executive (Hill et al., 2014). Malmendier and Tate (2005) and some later studies also used the net buyer to measure overconfidence. This is a market-based proxy, similar to the option-based measure, and it is determined by the tendency of some CEOs to buy additional firm stock despite their already high exposure to firm risk, i.e., if they bought stock on net in more years than they sold on net during their first five sample years (excluding the first five years of their tenure). This metric represents managers' predictions for high future stock performance or their risk tolerance. Earnings estimates, survey answers, and even psychometric tests are other indicators of CEO overconfidence. Although the option-based measure of overconfidence is the most popular and widely accepted in the literature; other measures could be used to draw more robust conclusions. Another limitation of the study is data availability for corporate governance elements. Even though we incorporated six elements of internal and external governance and employ three measures of overconfidence from 1996-2001, our results could have been more comprehensive if data for all determinants were available from 1993-2017. We are limited by Blockholders data from BoardEx, which is only available from 1996-2001.

Future studies could look towards creating a time-varying measure of overconfidence. It will allow researchers to examine how impacts alter when overconfidence levels rise or fall, as well as capture unobserved heterogeneity. The non-linearity of overconfidence could also be a promising research area. Future research could try to discriminate between mild and strong executive overconfidence. A continuous measure of overconfident will be useful for capturing this. Different managerial biases, including anchoring, loss aversion, and overconfidence, can also be considered together and interacted with to discover how they interact. For corporate governance measure, researchers could include more data from Thomson-Reuters 13F

filings or Governance QualityScore from Institutional Shareholder Services (ISS) to reach more definitive results. Governance QualityScore is a decile-based numerical number that compares a company's governance risk compared to its index or region. This research could be expanded in the future to look at the role of corporate social responsibility strategies as mediators. Recent research (Banerjee et al., 2015b; Kolasinski and Li, 2013) has begun to look carefully at how and when governance might alleviate management biases, which can be a promising area for future researchers.

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