

How Executive Characteristics Influence Firm Decision-Making: The Role of Overconfidence and Gender in the C-Suite

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10/13/2024

Abstract

I study the combined influence of two executive personal characteristics across the C-suite, overconfidence and gender, on firm-level decision making. I first document that non-CEO/non-CFO executives have a meaningful contribution to firm-efficiency-based measures of managerial ability. Examining overconfidence and gender, I find that both the combined treatment of these executive characteristics and the context play a meaningful role in our understanding of executive decision-making. The observed effects of overconfidence and gender are frequently driven primarily by one subgroup, but can also depend heavily on the firm decision analyzed. Moreover, the results frequently hold regardless of whether the executive holds the position of CEO or other positions in the C-suite. My findings highlight the importance of working to a holistic understanding of personal characteristics and executive decision-making.

* I would like to thank Shahram Amini, Mia Rivolta, and seminar participants at Illinois State University and the University of Dayton for their helpful comments.

1. Introduction

In recent years, a wide literature has evolved examining the impact of top manager personal characteristics on decision-making at the firm level. A motivating factor are results such as those documented by Bertrand and Schoar (2003), who find that managerial fixed effects play a significant role in explaining the differences in investment, financial, and organizational practices across firms. This leads to the natural question: what measurable or observable managerial characteristics influence decision-making? Answering this question has clear relevance for managerial selection, compensation, and oversight decisions, each a core function of corporate governance. Related research has greatly increased our knowledge of C-suite decision-making; yet, our understanding has been limited by research typically focusing on single characteristics primarily in isolation, largely treated as independent of other characteristics, or multiple characteristics treated as nearly perfect proxies for one another. Though these steps have been important in advancing the literature on managerial decision-making, we have yet to achieve a more holistic view of how the plethora of personal characteristics interact to shape the manager's view of the firm, and their resulting actions. Despite Bertrand and Schoar (2003) finding that executives beyond the CEO often have a significant and measureable impact on firm decision-making, the majority of empirical research has continued to focus primarily on the CEO, largely ignoring the potential importance of other top management team (TMT) members.

An interesting example stems from the literatures on executive overconfidence and executive gender. Extant studies have found that each of these characteristics influence executive decision-making, such as investing in innovation, internal growth, or M&A activity. However, the literature has diverged in its treatment of these personal characteristics. Perhaps driven by the history of male-dominated C-suites, particularly in S&P 1500 firms for which data is available,

many studies treat the two characteristics as independent of one another (Banerjee, Humphrey-Jenner, and Nanda, 2020; Huang, Tan, and Faff, 2016; Otto, 2014; Schrand and Zechman, 2012), either explicitly or implicitly. Other studies, relying on psychology data suggesting a high correlation between gender and (over)confidence in the general population (Beyer and Bowden, 1997; Deaux and Emswiller, 1974; Lenney, 1997; Lundenberg, Fox, and Puncnochaf, 1994), treat the two as highly or perfectly overlapping (Atkas, Louca, and Petmezas, 2019; Barber and Odean, 2001; Huang and Kisgen, 2013). However, either assumption is potentially flawed, as the C-suite is unlikely to be representative of the normal population particularly in terms of overconfidence (Goel and Thakor, 2008). In fact, the selective nature of the C-suite is likely to skew the baseline risk-taking preferences and overconfidence of executives relative to the average person. Thus, it is unclear what the combined effect of overconfidence and gender will be on executive decision-making, particularly in the context of investments with high potential risks. Largely, these studies have also left for future research the impact of top executives beyond the CEO (or CFO in a few instances), which may omit a higher portion of female executives.

My study takes one step in the direction of achieving a more holistic understanding of how executive characteristics interact to shape firm actions. Specifically, I examine the interaction of gender and overconfidence to influence firm actions for which each characteristic has been independently shown to be relevant: M&A activity, growth, and firm innovation.¹ To do so, I consider the impact of the five highest paid executives in the firm (top-5), where we see greater variation in both gender and overconfidence.² To support expanding the typical analysis beyond

¹ Of course, these are not the only possible executive characteristics worthy of such analysis; to the contrary, future studies could and likely should examine the joint effects of many executive characteristics. I select these two characteristics based on their common use in established literature, but also because of their inconsistent treatment across prior works.

² While the number of female CEOs in the S&P1500 has increased over time, it remains extremely male-dominated, with approximately 2.5% of our sample having a female CEO, compared to the average of 6.5% for the proportion of female top-5 executives. This allows for a more robust analysis further split into groups based on overconfidence.

the CEO, I first document that non-CEO/CFO top executives have a significant measureable impact on firm decision-making at a similar frequency (53%) to CEOs (61%). Moreover, because there are multiple such executives at each firm, the unconditional probability that no non-CEO/CFO top-5 executive has a significant impact at a particular firm is approximately 10%. In other words, at the vast majority of firms, we should expect other top-5 executives to have a meaningful impact, rather than the firm having a dictatorship structure completely dominated by the CEO.

Having established the importance of executive across the TMT, I next examine executive overconfidence and gender jointly, in each case using non-overconfident male executives as the baseline group. I begin by examining the combined influence of gender and overconfidence on M&A activity, where previous studies have shown that M&A activity is higher when the CEO is overconfident, but lower when the CEO is female. In particular, Malmendier and Tate (2008) argue that overconfident CEOs overestimate their ability to create value, leading them to overestimate the returns on investment, including M&A deals. Their findings suggest that overconfident CEOs invest more aggressively in M&A deals, leading to more M&A activity, but also overpayment and a more negative announcement return. However, their analysis assumes homogeneity within the cohort of overconfident executives; they do not consider additional personal characteristics. Focusing on the role of gender, Huang and Kisgen (2013) find that firms that experience male-to-female turnover for CEO and/or CFO become significantly less likely to complete mergers and acquisitions. They argue that this could be driven by male overconfidence or female risk aversion. Interestingly, either explanation could be consistent with value-destruction; overconfident male executives could overinvest in M&A or risk averse female executives could underinvest in M&A. Combined with evidence that female executives are significantly less likely to be fired, they argue

that male overconfidence is the more likely explanation. But importantly, all females are assumed to share identical risk-taking preferences/overconfidence in their empirical approach. While each study can offer important insights, both are potentially limited by treating gender as either irrelevant or as essentially a proxy strongly overlapping with overconfidence. I expand these tests by considering the joint effect of these two partially overlapping characteristics, and find a number of interesting results.

First, I note that contrary to what might be assumed based on the full population, there is a much smaller difference in overconfidence across genders in the C-suite, with 25% of male executive and 17.2% of female executives classified as overconfident across the broad sample of S&P1500 firms. Second, when I treat gender and overconfidence as independent but included simultaneously in the model, I find that the proportion of the top-5 executives that are female (overconfident) has a negative (positive) impact on the likelihood, frequency, and dollar value of firm M&A deals. I also find the proportion of female executives has a negative impact on the likelihood of an inter-industry M&A deal, but has no significant impact on payment method or short- or long-term deal performance. However, the significant effects are driven entirely by non-overconfident female executives; overconfident female executives do not differ significantly in their decision-making from their male counterparts, whether overconfident or not. Additionally, non-overconfident female executives are less likely to pursue a cash-only deal when the firm has below-industry Q, and achieve higher long-term performance in intra-industry M&A deals. This offers a more nuanced picture of the effects of overconfidence and gender on executive decision-making, at least in the context of M&A activity.

M&A deals are an interesting context as uncertainty can both be driven by asymmetric information (the acquiror having less information about the target than target insiders) and by

uncertainty regarding the C-suite's ability to have a positive impact on the value of the investment. Huang and Kisgen (2013) argue that this may also carry over to internal growth and firm financing decisions. Specifically, they find that male executives are more likely to issue debt and equity, contributing to higher asset growth compared to female executives, whose more conservative approach results in fewer debt and equity issuances. This pattern suggests that male overconfidence influences more aggressive financing decisions, while female executives tend to take a more cautious approach. When I examine the joint effects of overconfidence and gender on growth and financing decisions, I find evidence that both overconfident female and male executives have higher asset growth and are more likely to use equity financing, while non-overconfident female executives have no significant impact on either. On the other hand, non-overconfident female executives are significantly less likely to issue debt.

An equally interesting yet distinct context is firm innovation, as the investments are often high risk and can have a consequential impact on firm performance, but uncertainty is mainly “internal” rather than being driven by asymmetric information. This is an important distinction, as evidence in the psychology literature suggests that gender differences in self-confidence depend on uncertainty in terms of information/feedback, or lack thereof (Lenney, 1977). Because external and internal investment decisions can differ substantially in terms of available feedback (e.g., shareholder reaction to an announcement) and asymmetric information/uncertainty, these two contexts could also differ in terms of the effect of overconfidence across genders. Innovation is also an area where extant literature has shown, separately, a significant impact of executive gender (Wu, Dbouk, Hasan, Kobeissi, and Zheng, 2021; Chen, Lueng, and Evans, 2018; Griffin, Li, and Xu, 2021) and overconfidence (Einhorn, 1980; Griffin and Tversky, 1992; Hirshleifer, Low, and

Teoh, 2012). However, the interaction of these two personal characteristics need not be the same as in M&A deals, as the drivers of uncertainty and risk are meaningfully distinct.

I thus expand my analysis to consider the joint effects of gender and overconfidence on firm innovation. Again, I find a number of interesting results. First, I find that overconfidence has a positive effect across numerous measures of innovation, regardless of the executive's gender. However, I find that the effect is statistically and economically (approximately 5x) larger for female executives, particularly in innovative industries. Further, when I separate the effects of the CEO from other top-5 executives, I find that overconfident female top-5 executives are significantly more innovative, and this carries-over at least in part to OC female CEOs.³ On the other hand, the positive effect of overconfidence in male top-5 executives is driven entirely by CEOs; there is no significant effect (with the smallest p-value around 0.30) for non-CEO overconfident male executives. Thus, overconfidence appears to have more pervasive effects on innovative decision-making for female executives relative to male executives. My findings offer a more nuanced and detailed view of how these characteristics impact executive decision-making.

Taken together, my results support a more holistic view of gender and overconfidence, and their interaction to influence an executive's decision-making. Male and female C-suite executives are more similar than not in terms of overconfidence, but the impact of their overconfidence appears to differ based on the context. Because of this, my findings make a number of important contributions to the corporate governance literature. First, my results suggest that overconfidence and gender, and particularly their effects on decision-making, are neither closely overlapping or independent, but should be considered jointly. Second, my results offer further clarity regarding these combined effects in the context of two risky but potential valuable decisions: M&A deals

³ The small number of female CEOs may weaken our tests, leading to fewer significant results for female CEOs.

(external investments) and investment in innovation (internal investments). My findings suggest that overconfident female executives pursue M&A deals similar to the actions taken by their male counterparts in the C-suite, with only overconfident male executives behaving in a significantly more risk-taking manner in certain instances. On the other hand, non-overconfident female executives appear to take significantly less external risk than all other executives. This is quite distinct from the impact on internal risky investment, where overconfidence has a positive impact on risk-taking regardless of gender, but has a significantly stronger and more pervasive impact on female executive risk-taking. These results contribute significantly to our understanding of how these characteristics combine to influence decision-making, taking the first step towards a more holistic understanding of how an executive's "portfolio of personal characteristics" come together to shape their views of how the firm should operate. Finally, my findings have practical implications, as they highlight the need to consider the combined effect of managerial characteristics in executive selection as well as the setting of incentives and the governance structure to monitor the firm.

The remainder of the paper is structured as follows. Section 2 describes the data and empirical methods. Sections 3 and 4 present the results for M&A activity and firm innovation, respectively. Section 5 concludes.

2. Data and Methods

I construct my sample by integrating data from various sources. Because the focal point of my study is executive overconfidence and gender, I start by collecting executive-specific data for all S&P1500 firms from Execucomp. To expand the sample of female executives, I focus on the top 5 executives in each firm year in terms of total compensation (TDC1). Undoubtedly, CEOs play a crucial role in firm decision-making, but existing research suggests other C-suite members

play a significant role in addition to the CEO (Bertrand and Schoar, 2003; Garcia and Velasco, 2016; Kim et al., 2022). I supplement executive-specific data with firm-level data obtained from Compustat and stock return data from CRSP. This dataset excludes financial firms and utilities. Firm innovation is gauged using patent and citation data from Kogan et al. (2017), available on Noah Stoffman's academic website. Merger and Acquisition data is compiled from SDC (via Refinitiv Eikon) for which the acquirer is a public firm. Following Bena and Li (2013), smaller M&A transactions, defined as total deal values below \$10 million, are excluded from the sample. I integrate this data with the firm's accounting records, preserving all firm-year observations that have corresponding accounting data available, even when the firm-year recorded either zero patents and/or citations as well as zero mergers and acquisitions. I obtain governance metrics from ISS Risk Metrics, while institutional ownership data is extracted from 13F-HR filings via the SEC's Edgar database. Consequently, the sample consists of 11,379 firm-year observations spanning the period from 1996 to 2022.

2.1. Measuring Overconfidence and Gender

2.1.1. Executive-level Measure of Overconfidence

A widely utilized proxy for executive overconfidence relies on the premise that executives are subject to a substantial amount of firm-specific risk. Conventional wisdom suggests they should mitigate this risk as much as possible. First introduced by Malmendier and Tate (2005), Holder⁶⁷ leverages this idea, classifying an executive as overconfident if they neglect to exercise an 'in-the-money' option that is priced at least 67% above the exercise price. The underlying rationale is that a risk-averse executive would exercise these options to secure a guaranteed return and diversify their portfolio.

The 67% threshold originates from the model developed by Hall and Murphy (2002),

which assumes a constant relative risk aversion (CRRA) coefficient of 3. To be included in this categorization, an executive must demonstrate such behavior at least twice, and the exercisable options they hold must constitute a minimum of 50% of their total annual compensation, as per Execucomp's TDC1. Because overconfidence is perceived as a persistent trait, an executive is labeled as overconfident from their first instance of such behavior.

In the absence of detailed information on each executive's option package, I apply the methodology from Campbell et al. (2011) to compute the average moneyness of all exercisable options in each executive's portfolio. This involves scaling the average realizable value per option by the average exercise price. The average realizable value per option is derived by dividing the total realizable value of exercisable options (as indicated by the Execucomp variable OPT_UNEX_EXER_EST_VAL) by the total number of these options (OPT_UNEX_EXER_NUM). The resultant figure is then reduced by the stock price at the close of the fiscal year (PRCCF). This approach effectively omits unexercisable options, averting any risk of misclassifying an executive who possesses high moneyness options but lacks the ability to cash them in.

2.1.2. Firm-Level Measure of Executive Overconfidence and Gender

My study investigates the interplay between executive overconfidence and gender and its effects on firm innovation. Because of this, I establish several firm-level variables that measure the overconfidence and gender characteristics of the firm's C-suite. In doing so, I first categorize each individual executive as either male or female according to their GENDER designation in Execucomp. Next, for each executive-year I use Holder67 to classify each executive as either overconfident or not overconfident. This classification scheme creates four mutually exclusive groups. Namely, each executive is either an overconfident male, non-overconfident male,

overconfident female, or non-overconfident female in any given year. Subsequently, I form binary measures $I(\text{Overconfident-Male})\text{-CEO}$, $I(\text{Overconfident-Female})\text{-CEO}$, and $I(\text{Non-Overconfident-Female})\text{-CEO}$ that signify whether a firm-year had an overconfident male CEO, an overconfident female CEO, or a non-overconfident female CEO, respectively. Furthermore, I generate firm-level metrics of gender and overconfidence based on the top 5 C-suite executives ranked by total compensation. $P(\text{Overconfident-Male})\text{-top 5}$, $P(\text{Overconfident-Female})\text{-top 5}$, and $P(\text{Non-Overconfident-Female})\text{-top 5}$ are metrics denoting the proportion of overconfident male, overconfident female, and non-overconfident female executives, respectively.⁴

2.2. *Measuring M&A Activity*

I measure the firm's M&A activity in several different ways. For my primary tests, I define a binary measure $I(\text{M\&A})\text{-Deal}$ that indicates that the firm had at least one successful merger or acquisition bid in a given year. For robustness, I define $\text{Total}(\text{M\&A Number})$ as the total number of mergers and acquisitions that were completed in a given year and $\text{Total}(\text{M\&A Dollar Amount})$ as the total dollar amount (in millions of USD) spent by the acquiror on completed M&A bids in a given year. In all cases I include firm-years from Compustat in which a firm did not complete any successful M&A deals. Because I control for firm-specific unobservables, I exclude firms that never completed a single merger or acquisition across the entire sample. That is, I require within-firm variation in terms of annual merger and acquisition deals.

2.3. *Measuring Innovation*

I follow prior relevant literature and employ several proxies for firm innovation based on patent and citation data (Hirshleifer et al., 2012; Chen et al., 2018; Wu et al., 2021). I begin with

⁴ As a robustness test, I use the binary measures of these same variables. These measures begin with a prefix "I" rather than "P". For example, $I(\text{Overconfident-Female})\text{-top 5}$ is binary and indicates that a particular firm-year had at least one overconfident female in the C-suite. The descriptions of other proportion measures are analogous to indicators described above. A detailed description of all variables is available in the Appendix.

the entire history of U.S. patent data collected via Google Patents. Using this data, I assign each individual patent application to public firm-years in the Compustat database dropping the patent applications for which I do not have firm accounting data. Then, I construct several proxies for firm innovation, all of which are aggregated at the firm-year level using individual patent data. Patent Count is the total number of patent applications that eventually approved. I match using the submission year rather than the granting year as it is a more accurate measure of the firm's innovativeness for the current C-suite.

In addition to raw patent counts, I employ several other measures of innovation that aim to capture the quality of the patent. Patent Value – Nominal is the value of innovation in millions of nominal dollars. Patent Value – Real is the value of innovation in millions of real dollars deflated to 1982. Another common measure that captures the quality of a patent is the patent's citation count. However, using a simple citation count induces truncation bias. That is, recently approved patents have not had an equivalent amount of time to accumulate citations compared to older patents, despite potentially being higher quality. To address this issue, I follow Hirshleifer et al. (2012) in developing two measures. For the first correction, the citation count for each patent is normalized by comparing it to the average citation count of all patents in its respective technology class and year of application. I then define $TT_{citation}$ which represents the aggregate of the adjusted citation counts for all the patents that the company has applied for within that specific year. For the second correction, every patent's citation count is weighted in accordance with the index proposed by Hall, Jaffe, and Trajtenberg (2001, 2005). Subsequently, $Q_{citation}$ represents the total of these corrected citation counts from all patents filed within that particular year.

2.4. *Descriptive Statistics*

Table 1 presents summary statistics for overconfidence stratified by gender for the entire

Execucomp database and describes overconfidence differences across gender on a broad sample of executives. Panel A reports the total number of executives at the individual level, limited to the top five executives. There are 48,793 unique individuals, 4,244 (8.7% of the total sample) of which are female executives, and 730 (1.5% of the total sample) are overconfident female executives. Lastly, 25% of all male executives are overconfident while only 17.2% of female executives are overconfident at any point during the sample period. This is consistent with the literature that argues men are more likely than women to be overconfident, on average (Barber and Odean, 2001). However, this difference is relatively small, suggesting that gender is a poor proxy for overconfidence. In an unreported tabulation, I find that CEOs are much more likely to be overconfident relative to the rest of the C-suite. Namely, 49% of CEOs are overconfident while only 27.4% of non-CEOs are labeled as overconfident. This is consistent with Goel and Thakor's (2008) prediction that overconfident managers are more likely to be promoted to CEO. Interestingly, 43.8% of female CEOs are overconfident compared to just 28.3% of non-CEO male executives. Further, 49.2% of male CEOs are labeled as overconfident indicating that the CEO-to-non-CEO difference is larger than the male-to-female difference, again implying that using gender as a proxy for overconfidence may be inappropriate.

Panel B of Table 1 gender and overconfidence characteristics at the executive-year level, limited to the top five executives, including the CEO. There are a total of 218,529 unique executive-firm-years, 15,676 (7.2% of total sample) of which are female, and 4,660 (2.1% of total sample) of which are overconfident females. This panel shows a similar overconfidence difference between genders as 29.7% and 39.2% of executive-years are overconfident females/males respectively. These figures are up from those reported in Panel A due to the construction of *Holder67*. This is because once an executive is identified as overconfident, he/she remains

classified as overconfident as long as he/she is in the sample.

Table 2 presents summary statistics for variables used to predict successful merger and acquisition bids. This sample consists of 8,141 firm-years. The dependent variable, I(M&A Deal), is binary and indicates a successful merger or acquisition bid, and make up 32.2% of firm-years. I(M&A Number) is the total number of successful M&As per firm-year. Most firm years have 0 M&As, with a mean of 0.46 and a max of 12. I(M&A Amount) is the total dollar amount (in millions) spent on M&A per firm year. This data is highly positively skewed as the mean total spent in a given year is \$404M, while the max is \$79,406.

Table 2 also presents descriptive statistics on variables of interest, namely, gender and overconfidence characteristics of the top 5 executives. For all gender/overconfidence measures, a “P” prefix refers to a proportion and an “I” prefix refers to an indicator. Finally, a “top 5” and “CEO” suffix refers to either the top 5 executives and the CEO, respectively. For example, P(Female)-top 5 indicates that the average firm-year’s top 5 executives are 6.5% female. However, 23% of firm-years have at least one female in the top 5 executives. Further, the mean percent of (non)overconfident females is 3.2% and 3.1% respectively. Lastly, the average proportion of overconfident male executives is about 53%.

Table 3 outlines the descriptive statistics for the sample used to explore the relationship between executive overconfidence, gender, and firm innovation. Initial observations reveal that around 7% of top 5 executives, on average, are females. Overconfident and non-overconfident females constitute about 3.3% and 3.7% of this group, respectively. Yet, non-reported statistics indicate that approximately 23% of all firm-years feature at least one female executive. A deeper dive shows that about 11.3% of firm-years include at least one overconfident female executive, and 13.4% of firm-years have at least one non-overconfident female executive. When focusing on

the CEO position, data reveals that around 3.3% of firm-years have a female CEO, 2.1% feature an overconfident female CEO, and 1.1% have a non-overconfident female CEO.

Turning to the patent data, the mean number of patents per year is about 44 with a median of just 1 indicating substantial positive skewness. In fact, about 49% of firm-years have zero patents. Similarly, about 52% of firm-years have zero citations, with a mean of 478 citations in a given firm-year. Further, the average patent receives about 10.8 citations, although this is also highly skewed. Lastly, the average patent garners roughly \$1.5M in value for the firm.

3. Empirical Analysis and Results

3.1. Top-5 Executives and Influence at the Firm (Managerial Ability)

I begin my empirical analysis by investigating whether non-CEO/CFO top executives have a meaningfully observable influence at S&P-level firms. While it is well accepted that CEOs have substantial decision-making power across firm decisions, and CFOs have significant influence over financing-related choices, the impact of other TMT members is not well established in the literature. This is an importantly underlying aspect of my study, as I seek to better investigate the impact of a characteristic, gender, that thus far has had little variance at the CEO level, with the vast majority of CEOs of large public companies being male.

To investigate the influence of non-CEO or CFO top executives, I follow a process similar to Dermjian, Lev, and McVay (2012). Specifically, I analyze the impact of individual executives on the Managerial Ability proxy using executive fixed effects, after accounting for both time and firm fixed effects. For the analysis, I consider three groups of executives: (1) CEOs, (2) CFOs, and (3) the three highest paid executives not holding the position of CEO or CFO, generally reflecting the “top 5” executives at the firm.

I first identify all executives in the Execucomp universe that were employed by more than

one Execucomp firm during the period from 1992-2023. Being employed at multiple firms is critical for estimating the impact of an executive that is separate from the firm's fixed effect. I find that approximately 5,300 executives meet this criteria, across 22,600 firm-years. I then create a fixed effect for each executive. I create separate indicators for the executive holding the position of CEO (CFO) for each firm, and interact this with the executive fixed effect. This allows me to separately estimate the effect of executives who were only CEOs, only CFOs, or the different effects of an executive at a firm where they held the position of CEO (CFO) vs. at a firm where they were a non-CEO/CFO top-5 executive. I then aggregate the data to the firm-year level, to analyze the impact of each executives controlling for the impact of the other top-5 executives. To examine the impact of executives, I employ an updated version of the Managerial Ability measure from Demerjian et al. (2012).⁵ Managerial Ability is calculated using a two-step method assessing how efficiently managers convert corporate resources into revenues relative to their industry peers. In the first step, Data Envelopment Analysis (DEA) is used to generate a firm efficiency score, considering various revenue-generating inputs including inventory, R&D, fixed assets, and administrative expenses. Firms operating on the efficiency frontier receive a score of 1, while less efficient firms receive lower scores (with a lower bound of 0). This initial efficiency measure is influenced by both firm-specific factors and managerial characteristics. To address this, the second step refines the efficiency score by regressing it against firm-specific characteristics such as size, market share, and complexity of operations, which could either aid or hinder efficiency. The residuals, which represent the portion of firm efficiency unexplained by these factors, are attributed to managerial ability. Two key updates were made following publication, replacing the second-stage Tobit model with OLS (improving robustness), and estimating both stages by year.

⁵ We thank Peter Demerjian for making this available on his website (<https://peterdemerjian.weebly.com/>).

I regress the updated Managerial Ability measure on the executive fixed effects and CEO/CFO effects, after accounting for firm and year fixed effects. Standard errors are clustered at the firm level. The results are presented in Table 4. For comparison with the results of Demerjian et al. (2012), I first include only the fixed effects for CEOs in the model. I find that 80.6% of CEO fixed effects are significant at the 10% level. This is even stronger than the effects found by Demerjian et al. (2012), who find up to 66.5% of CEO fixed effects are significant.⁶ After adding CFO fixed effects, I find that 72.7% of CEOs have a significant impact, while 61.4% of CFOs also have a significant impact on the managerial ability measure. Finally, when all top-5 executive indicators are included, I find that 60.9% of CEOs have a significant impact as CEO⁷, 65.0% of CFOs have a significant impact, and 52.8% of other top-5 executives have a significant impact. This helps to establish that, while CEOs and CFOs more often have a significant impact on the company, other top executives also have a significant impact and at a substantially similar rate. Moreover, this would suggest that unconditionally there is only an approximate 10% chance that none of the remaining three top-5 executives have a significant effect, after accounting for the influence of the CEO and CFO. Thus, it is highly likely that non-CEO/CFO top-5 executives will have a significantly measurable influence on their firm. Having established this, I now analyze the joint effects of overconfidence and gender using the entire top-5 executive TMT.

3.2. *Executive Overconfidence, Gender, and M&As*

I evaluate the impact of executive overconfidence and executive gender on the merger and acquisition behavior of the firm in a multivariate setting with controls. These regressions take one of the general forms:

⁶ This increase in significance could be driven by the updated Managerial Ability measure, the substantially increased sample period, or both.

⁷ Note that this is in addition to the manager's baseline impact (from non-CEO positions) if they held non-CEO positions during the sample period.

$$(1) \text{Prob}\{Y_{i,t} = 1 | O_{i,t}, G_{i,t}\} = F(\gamma_0 + \alpha_i + \tau_t + \gamma_1 OG_{i,t} + \theta X_{i,t} + v_{i,t})$$

$$(2) Y_{i,t} = F(\gamma_0 + \alpha_i + \tau_t + \gamma_1 OG_{i,t} + \theta X_{i,t} + v_{i,t})$$

Where equation (1) is estimated in a logistic regression and equation (2) is OLS. In equation (1), Y_{it} is binary and takes the value of one for a firm-year in which the firm completed at least one successful merger or acquisition. In equation (2), Y_{it} is continuous, as either the M&A deal value or premium. α_i are firm fixed effects and τ_t are year fixed effects. $X_{i,t}$ is a set of control variables which includes characteristics of the firm, executives, and the board of directors. Firm controls include size, Q, cash flow, debt, and R&D. Executive-specific controls include the total number of stocks held by the top 5 executives as a proportion of total shares, the total dollar amount of vested options held by the top 5 executives, the average age of the top 5 executives, and the tenure of the CEO. Finally, governance controls include board size, the proportion of the board that is female, and the proportion of the board that are independent directors.

OG_{it} is a set of predictors that measures the intersection of overconfidence and gender. A binary rule is used to first identify gender and overconfidence separately, and then group individuals into four groups based on gender and overconfidence, as described in section 3. The covariates of interest are the proportion of the top 5 that make up each of the 4 categories (e.g., $P(\text{Overconfident-Female-top 5})$ is the proportion of the top 5 executives that are overconfident females).

3.2.1. *M&A Activity*

Table 4 reports the results analyzing the likelihood, dollar value, and premium paid in M&A events based on the proportion of top-5 executives in each group.⁸ First, in Column (1) I test the

⁸ $P(\text{Non-Overconfident-Male-top5})$ is excluded from the analysis, and thus, serves as the baseline when interpreting the results.

effect that female executives and overconfident executives have on M&A activity, separately. In essence, I am testing Malmendier and Tate (2008) and Huang and Kisgen (2013) jointly. Consistent with related literature, I find that female executives are associated with significant reduction in M&A activity while overconfident executives are associated with a significant increase in M&A activity, controlling for one another. However, this misses valuable variation. In column (2), I explicitly test the joint effects of overconfidence and gender on M&A activity by splitting $P(\text{Female})\text{-top } 5$ into $P(\text{Overconfident-Female})\text{-top } 5$ and $P(\text{Non-Overconfident-Female})\text{-top } 5$, and controlling specifically for $P(\text{Overconfident-Male})\text{-top } 5$, making non-overconfident male executives the reference group. I find that the negative effect that female executives have on the firm's M&A activity is driven entirely by females who are not overconfident. Further, overconfident female executives have no effect. In other words, it appears that female executives do not have a uniformly negative effect on M&A activity. Rather, the effect of female executives appears dependent on overconfidence. Finally, I find that firms with a higher proportion of overconfident men are significantly more acquisitive, relative to their non-overconfident counterparts. Given that the vast majority of executives are male, this finding is unsurprising in light of Malmendier and Tate's (2008) finding that overconfident CEOs are more acquisitive.⁹

In Column 3, I report the results from the second stage of an IV analysis, in which I instrument for the proportion of non-overconfident female executives using board members' negative experiences with overconfident female executives at other firms. I define a negative experience as a firm-year in which the firm was below the 25th percentile of industry-adjusted Tobin's Q, which reflects a lower valuation relative to book value. Specifically, I consider instances

⁹ One may argue that firms are increasingly more acquisitive with each additional overconfident male executive in the C-suite. This is important to consider given that about 60% of firm-years have 2 or more overconfident male executives compared with just 1.4% of firm-years that have 2 or more non-overconfident females. Thus, using proportions is a more robust specification compared to using indicators. For comparison, this test is repeated using indicators for overconfidence/gender variables and can be found in Appendix C.

where board members, while serving on boards of firms other than the focal firm, encountered overconfident female executives during these underperforming years. The rationale is that if a board member has previously been involved with a firm that struggled under the leadership of an overconfident female executive, they may be more inclined to prefer non-overconfident female executives in future leadership decisions. Since these past experiences are unrelated to the performance of the focal firm, they serve as a valid instrumental variable. Consistent with this logic, first stage regression results show a significantly positive effect of board member negative experience on the proportion of non-overconfident female TMT members. I then use the instrumented value of the proportion of non-overconfident female TMT members, and continue to find a strong negative and significant impact on the likelihood of completing an M&A deal.

Although I have documented above that all top 5 executives may have significant influence over firm decisions, one possible criticism is that not all executives have equal influence on firm decision-making. To address this concern, I consider the widely held belief that the CEO is the most influential C-suite member – especially when it comes to major corporate decisions like mergers and acquisitions. In untabulated tests, I control for CEO gender and overconfidence characteristics, and document the effect of the additional non-CEO executives. Interestingly, I find a small positive effect from an overconfident male CEO (significant only at 10%), but a much larger negative effect from the proportion of non-overconfident female executives. The latter finding is significant at 1%.

Following related literature, I also perform a number of additional tests by examining several characteristics of merger and acquisition transactions. First, I expand the tests to examine the total deal value rather than simply the likelihood of an M&A transaction. In Column 4, I again find that, independently, the proportion of female executives have a negative impact, while the

proportion of overconfident executives have a positive impact on deal value. In Column 5, I again examine the joint impact of gender and overconfidence. Similar to Column 2, I find that non-overconfident female executives have a negative impact on total deal value, while overconfident male executives have a positive impact on total deal value, both relative to non-overconfident male executives. Overconfident female executives have not significant impact. In Column 6, I repeat these tests using the IV specification from Column 3, and confirm the results from Column 5.

Next, I consider the deal premium paid. Levi et al. (2014) document a negative relationship between the fraction of the board composed of female directors and premium paid for M&As. In theory, I expect a similar effect from female executives and a pronounced effect from non-overconfident female executives. That is, because female executives apply a larger discount rate to the future cash flows of acquisitions, they will formulate a lower valuation. Further, because overconfident female executives overestimate cash flows relative to non-overconfident female executives, the net effect that overconfident female executives have on M&A valuation, and premium paid, is unclear.

In Column 7, I examine the impact on premium paid, using the total M&A deal value scaled by the target's EBITDA as a proxy. I find that the proportion of female executives has a negative effect, while overconfidence does not have a significant effect. When I analyzing gender and overconfidence jointly (Column 8), I find that non-overconfident female executives have a negative impact on the premium paid, while no other executives have a significant impact. However, these results are sensitive to the IV specification. I cannot rule out the possibility that this is driven by low power due to a relatively small sample size, as no variables are significant in this specification. Although not reported in a table, I find similar results after controlling for the CEO's overconfidence/gender, for both the deal value and premium paid.

Of course, another possibility is that the effects of overconfidence and gender are dependent on the type and/or payment method of the M&A deal. For example, Malmendier and Tate (2008) find that overconfident CEOs have a significant positive effect on diversifying (i.e., inter-industry) M&As, but no effect on non-diversifying (i.e., intra-industry) M&As. One interpretation is that because overconfident executives overestimate their ability to generate large returns, they are more willing to step outside their expertise and pursue inter-industry mergers. Hence, we would expect overconfident male executives to be more likely to make inter-industry M&As and non-overconfident female executives to be less likely make inter-industry M&As.¹⁰

In Columns 1 and 2 of Table 6, I present results predicting inter-industry and intra-industry M&As, separately. A merger or acquisitions is classified as inter-industry when the acquirer and the target operate in a different industry according to the SDC database. An intra-industry merger or acquisition occurs when the acquirer and target are in the same industry. In Column 1, I find that firms with a larger proportion of non-overconfident female executives are significantly less likely to complete an inter-industry merger or acquisition relative to their male counterparts. As before, overconfident female executives do not have a significant impact, while overconfident male executives have a positive impact on the likelihood of completing inter-industry deals. Results are generally similar for the likelihood of an intra-industry M&A deal with the exception that the impact of non-overconfident female executives is marginally insignificant ($p\text{-value} = 0.13$). However, in untabulated IV specifications following those used in Table 5, I find that non-overconfident female executives have a negative and significant impact on both the likelihoods of inter- and intra-industry deals, consistent with Table 5.

Malmendier and Tate (2008) also show that overconfident CEOs are more likely to pay

¹⁰ I use the labels “inter-industry” (“intra-industry”) to describe M&As in which the acquirer and the target are in different (the same) industry. This naming convention avoids the confusion associated with “diversifying M&A” as described above.

with cash when the CEO is likely to believe their firm as being undervalued by the market. In column (3) of Table 6, I report results predicting M&As in which the payment method was cash only. Results indicate that firm with a higher proportion of females tend to complete significantly fewer cash-only deals when the firm's Q is below the industry median, regardless of overconfidence. On the other hand, overconfident male executives have a positive impact on the likelihood of a cash deal when the firm's Q is below industry median. No group has a significant effect when the firm is relatively highly valued. This result again highlights the importance of considering overconfidence and gender jointly, as the combined effect can be context-dependent.

Lastly, I investigate the value implications at announcement and post-merger. In terms of expectations, there are many different mechanisms at play. To begin, because overconfident executives overestimate the cash flows, they also overvalue returns on M&As. Thus, if the market correctly values M&A deals made by overconfident executives, they will respond negatively resulting in value destruction. On the other hand, the lower propensity to engage in M&A activity by non-overconfident female executives could be viewed positively by the market, and have long-term positive performance implications. In other words, if the firm is perceived to be overinvesting, M&As completed by overconfident executives will be viewed negatively. It is also possible that M&As made by firms with female executives induce additional complexity. That is, the market may perceive firm actions differently depending on the personal traits of the firm's executives, independent of the firm's optimal investment strategy. For example, Lee and James (2007) document a negative "gender bias" with respect to the market reaction to female CEO appointments. That is, when the firm announces that the next CEO will be female, the 3-day CAR tends to be negative. Together, these considerations make it very difficult to generate a prediction regarding the market's response to M&As completed by firms with varying executive

overconfidence and gender characteristics. Given these dynamics, the market's response is an empirical question.

Columns 5 and 6 of Table 6 report results for the market's reaction to M&A announcements, using the 3-day (-1, +1) cumulative abnormal return (i.e., CAR). Following extant literature, I test inter-industry and intra-industry M&As separately. Regardless of deal type, I find no evidence that the overconfidence and gender characteristics of the firm's C-suite have no significant effect on the CAR surrounding the M&A announcement.

In addition to market reaction, I investigate the long-run operating performance of the combined firm post-M&A, which is not subject to potential gender bias from the market. I define long-run operating performance as the change in industry-adjusted abnormal ROA of the combined firm from 3 years after M&A completion ($t + 3$) to the pre-M&A completion year ($t - 1$) (Li and Peng, 2020). The sample is restricted to public target firms to measure each target firm's ROA pre-M&A. Results are displayed in Columns 7 and 8 of Table 6. I find that the C-suite's overconfidence and gender characteristics are not predictive of long-run post-M&A operating performance for inter-industry M&A. However, a larger proportion of non-overconfident female executives is associated with improved post-M&A operating performance for intra-industry M&A. This suggests that firms may benefit from the more conservative approach to M&As taken by non-overconfident female executives, which may help to avoid poor acquisitions and overpayment. To my knowledge, these are novel findings indicating that not only do we need to consider overconfidence differences *between* genders, but it is also important to consider overconfidence differences *within* each gender. Lastly, these findings add to the evidence that shows that personal characteristics of the entire C-suite are consequential for firm outcomes, not just the CEO.¹¹

¹¹ Results are unchanged if I consider the total number of completed M&As as the dependent variable.

3.3. *Growth and Financing Decisions*

I next consider the joint effects of overconfidence and gender on firm growth and financing decisions, building on Huang and Kisgen (2013). Huang and Kisgen demonstrate that male executives are more likely to take ‘overconfident’ actions compared to female executives in key corporate decisions. Specifically, they find that male executives are more inclined to undertake acquisitions, issue more debt and equity, and expand the firm’s assets relative to female executives. Their results highlight that executive gender influences capital structure decisions, and the authors argue that male overconfidence is the driving factor. However, their study does not directly measure overconfidence or explore the interplay between overconfidence and gender in the C-suite. As such, I next examine the joint effects of overconfidence and gender on asset growth, total debt issuance, and total equity issuance. The results are presented in Table 7.

In Columns 1-3, the dependent variable is firm asset growth. In Column 1, I find that overconfidence has a marginally significant positive impact on asset growth, while gender is insignificant. When examining the joint impact of gender and overconfidence in Column 2, I find that the positive effect of overconfidence is driven entirely by overconfident female executives (coeff. = 0.139, p-value = 0.006); overconfident male executives have a smaller and insignificant positive effect (coeff. = 0.027, p-value 0.167). However, the impact of overconfident female executives is no longer significant in the instrumental variable specification (Col. 3).

In Columns 4-6, I analyze the probability of a debt issuance. When examining gender and overconfidence separately (Col. 4), I find that neither has a significant impact. However, when I consider the joint effects (Col. 5), I find that neither overconfident female or male executives have a significant effect, but non-overconfident female executives are significantly less likely to undertake a debt issuance. This is confirmed in the instrumental variable specification (Col. 6).

Finally, in Columns 7-9, I investigate the impact of gender and overconfidence on the likely of equity issuance. When analyzed separately (Col. 7), I find that gender has an insignificant effect while overconfidence has a marginally significant positive effect. When considered jointly (Col. 8), I find a highly significant positive impact from overconfident male executives, and no significant impact from female executives regardless of overconfidence. This result changes in the IV specification (Col. 9), where I find that both overconfident female and overconfident male executives have a positive impact on the likelihood of equity issuance. This again highlights the importance of considering the effects jointly, as independent analysis can mask the nuanced effects of overconfidence and gender in ways that vary depending on the context.

3.4. *Firm Innovation*

Lastly, I investigate the joint impact of overconfidence and gender on firm innovation. Specifically, I examine the joint impact on the firm's patents, citations, and measures of patent quality. My empirical specification, therefore, takes the following general form:

$$(1) \text{Innovation}_{i,t} = f(\text{Overconfidence \& Gender Characteristics}_{i,t} + \text{Firm Characteristics}_{i,t} + \text{Executive Characteristics}_{i,t} + \text{Board Characteristics}_{i,t} + \text{Ownership Characteristics}_{i,t} + \text{Year Effect}_t + \text{Firm Effect}_i)$$

where equation (1) is OLS. *Innovation_{i,t}* is a proxy for firm innovation (e.g., Patent Count), and *Overconfidence \& Gender Characteristics_{i,t}* are firm-level measures of the overconfidence and gender characteristics of the C-suite. *Firm Characteristics_{i,t}* include the natural log of sales, the natural log of property plant and equipment scaled by total employees, and the previous year's stock return. *Executive Characteristics_{i,t}* include the tenure of the CEO, the natural log of one plus the average Delta for the top 5 executives, and the natural log of one plus the average Vega for the top 5 executives. *Board Characteristics_{i,t}* account for the natural log of the board of

directors' size, the proportion of the board of directors with independent seats, and the proportion of the board of directors who are female. Lastly, *Ownership Characteristics_{it}* refer to institutional ownership, expressed as a percentage of total stockholder's equity. I use several proxies for firm innovation. Patents is the total number of patents applied for in a given firm-year. Qcитайon is the total number of citations summed across all patents applied for during the year, with each patent's number of citations is multiplied by the weighting index from Hall, Jaffe, and Trajtenberg (2001, 2005). Lastly, Patent Value – Real is the total value of innovation in a given firm year expressed in millions of 1982 dollars adjusted by CPI.

I present the results of this analysis for all firms in Table 8. Columns 1-3 present the results for the natural log of the number of patents the firm received. In Column 1, evidence that both female and overconfident executives independently have a positive impact on patent activity. When I consider the joint impact of overconfidence and gender (Col. 2), I find that both male and female overconfident executives have a significantly positive impact on innovation. However, the impact of overconfidence among female executives is considerably stronger at nearly 6x the magnitude and greater statistical significance (p-values = 0.001 vs 0.072). Importantly, the two effects are significantly different (p-value = 0.005). This result is unchanged in the IV specification in Column 3. In Columns 4-6, I examine total patent citations. When I analyze gender and overconfidence separately (Col. 4), I again find that each has a positive and significant independent effect. When I consider these jointly (Col. 5), I again find that overconfident female executives have a strongly significant positive impact, overconfident male executives have a (statistically) smaller positive impact, and non-overconfident female executives do not differ from their male counterparts. Results are similar in the IV specification (Col. 6), except that overconfident male executives have a marginally insignificant positive impact on patents (p-value 0.105).

I also consider the real value of patents, defined as the nominal value of innovation deflated to 1982 (million) dollars using CPI. The nominal value of innovation is calculated based on the stock market's reaction to the announcement of a patent grant, reflecting the market's valuation of the innovation's future economic benefits to the firm. A similar pattern emerges (Columns 7-9), with overconfident female executives exhibiting a significantly larger impact on the real value of innovation compared to their male counterparts. Although not reported in a table, results are similar if I instead consider per-patent citations or real value, or the nominal value total or per patent. Results are also generally similar if I control for the CEO's characteristics. Additionally, consistent with related literature, I find that overconfident CEOs have a significant positive effect on firm innovation across all innovation proxies. I continue to find that firms with a greater proportion of overconfident female executives have greater innovative activities across all proxies. Lastly, I find that firms with a non-overconfident female CEO attain significantly less patents and patent citations, although this effect is estimated using a relatively small sample of non-overconfident female CEOs.¹²

Following Hirshleifer et al. (2012), I next examine whether the effects differ depending on the innovativeness of the firm's industry. To distinguish between innovative and non-innovative industries, I classify an industry as innovative if its prior-year average Q_{citation} count per patent surpasses the median Q_{citation} count calculated across all industry categories. For the purposes of this categorization, industry classifications are based on their two-digit SIC codes. I then interact all executive overconfidence and gender metrics with a binary variable indicating whether a firm is part of an innovative industry, and repeat the tests to examine the impact on patents, citations, and value. Table 9 reports the results. Consistent with expectations from prior literature, I find that

¹² Although this sample is relatively small, relevant literature has derived results from smaller samples. For example, Lee and James (2007) find that the market tends to react negatively to female CEOs using a sample of just 17 female CEOs. This is in comparison to my sample of 84 female CEOs and 240 female CEO firm-years.

the positive impact of overconfident female and male executives occurs exclusively at firms operating in innovative industries. This holds across all three measures of innovation, and I continue to find that overconfident female executives have a significantly stronger positive impact than do male overconfident executives, within innovative industries.

4. Conclusion

As a step towards a more holistic view of how personal characteristics influence the C-suite, I study the combined influence of two executive personal characteristics, overconfidence and gender, that have been previously documented to have separate but significant effects at the firm level. I focus on three important yet meaningfully distinct contexts: M&A activities, growth and financing decisions, and innovation. I find that both the combined treatment of these executive characteristics and the context play a substantial role in our understanding of how such characteristics impact executive decision-making. Specifically, I find that lower M&A activity by firms with female executives is driven entirely by the subset that are not overconfident, as is the lower prevalence of debt issuances. Overconfident female executives do not differ materially from their average male counterparts, and only appear to invest less aggressively than overconfident male executives in certain instances. In fact, I find some evidence that overconfident female executives achieve higher firm growth and more frequently issue equity. Overconfidence plays a stronger and more pervasive role for female executives in encouraging innovation: overconfident female executives are more likely to innovate than any other executives. Moreover, the positive effect of overconfidence carries over for female executives at different levels of the C-suite hierarchy, increasing innovation whether the executive is the CEO or holds another position in the C-suite. My findings highlight the importance of working to a holistic understanding of personal characteristics and executive decision-making, suggesting a more nuanced view of gender and

overconfidence, and their interaction to influence an executive's decision-making. Overconfidence and gender are neither closely overlapping or independent, but should be considered jointly. This also highlights the need to consider the combined effect of managerial characteristics in executive selection as well as the setting of incentives and the governance structure to monitor the firm.

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Table 1: Overconfidence Stratified by Gender*Panel A: By Executive (top 5 executives)**n = 48,793*

	Total			% of Total			% of Total Gender	
	Female	Male	Total	Female	Male	Total	Female	Male
Not Overconfident	3,514	33,414	36,928	7.2%	68.5%	75.7%	82.8%	75.0%
Overconfident	730	11,135	11,865	1.5%	22.8%	24.3%	17.2%	25.0%
Total	4,244	44,549	48,793	8.7%	91.3%	100.0%	100.0%	100.0%

*Panel B: By Executive-firm-year (top 5 executives)**n = 218,529*

	Total			% of Total			% of Total Gender	
	Female	Male	Total	Female	Male	Total	Female	Male
Not Overconfident	11,016	123,364	134,380	5.0%	56.5%	61.5%	70.3%	60.8%
Overconfident	4,660	79,489	84,149	2.1%	36.4%	38.5%	29.7%	39.2%
Total	15,676	202,853	218,529	7.2%	92.8%	100.0%	100.0%	100.0%

Table 2: Summary Statistics – M&A

This table provides summary statistics for variables used to predict M&A occurrences. I(M&A Deal) indicates a firm had at least one successful M&A in a given year. Total(M&A Number) is the total number of successful M&As per firm-year. Total(M&A Dollar Amount) is the total dollar amount (in millions) spent on successful M&A bids per firm-year. Size is log of total assets. Q is the market value of assets scaled by the book value of assets. Cash Flow is earnings before extraordinary items and depreciation scaled by total assets. Debt is current plus long-term debt scaled by total assets. R&D is research and development scaled by sales. Total Stock Ownership-top 5 is the total number of shares held by the top 5 executives scaled by the total number of shares outstanding. Total Vested Options-top 5 is the total number of vested options held by the top 5 executives scaled by the total number of shares outstanding multiplied by ten to match the scaled of Total Stock Ownership-top 5. Age-top 5 is the average age of the top 5 executives. Board Size is the log of the total number of board members. P(Female)-Board is the proportion of board members that are female. P(Independent)-Board is the proportion of independent board members. Tenure-CEO is the CEO's tenure with the firm. P(Female)-top 5 is the proportion of the top 5 executives who are female. P(Overconfident-Female)-top 5 is the proportion of the top 5 executives who are overconfident females. P(Non-Overconfident-Female)-top 5 is the proportion of the top 5 executives who are female and not overconfident. P(Overconfident-Male)-top 5 is the proportion of the top 5 executives who are overconfident males. P(Non-Overconfident-Male)-top 5 is the proportion of the top 5 executives who are male and not overconfident

Statistic	N	Mean	St. Dev.	25%	Median	75%
P(Female)-top 5	8,141	0.065	0.135	0	0	0
P(Overconfident-Female)-top 5	8,141	0.033	0.100	0	0	0
P(Non-Overconfident-Female)-top 5	8,141	0.032	0.095	0	0	0
P(Overconfident-Male)-top 5	8,141	0.531	0.361	0.200	0.600	0.800
P(Non- Overconfident-Male)-top 5	8,141	0.404	0.358	0	0.400	0.750
I(Overconfident-Male)-CEO	8,141	0.702	0.458	0	1	1
I(Overconfident-Female)-CEO	8,141	0.018	0.133	0	0	0
I(Non-Overconfident-Female)-CEO	8,141	0.006	0.078	0	0	0
I(M&A Deal)	8,141	0.322	0.467	0	0	1
Total(M&A Number)	8,141	0.462	0.836	0	0	1
Total(M&A Dollar Amount)	8,141	403.9	2,495	0	0	61.6
Size	8,141	8.094	1.484	6.968	8.052	9.179
Q	8,141	2.149	1.557	1.284	1.703	2.417
Cash Flow	8,141	0.093	0.088	0.062	0.094	0.133
Debt	8,141	0.261	0.202	0.137	0.257	0.361
R&D	8,141	0.058	0.274	0	0.008	0.053
Total Stock Ownership-top 5	8,141	0.016	0.031	0.002	0.005	0.014
Total Vested Options-top 5	8,141	0.014	0.015	0.004	0.009	0.018
Age-top 5	8,141	53.781	4.635	51.000	54.000	56.667
Board Size	8,141	2.228	0.240	2.079	2.197	2.398
P(Female)-Board	8,141	0.136	0.107	0.071	0.125	0.200
P(Independent)-Board	8,141	0.689	0.255	0.625	0.778	0.875
Tenure-CEO	8,141	7.493	6.865	3	6	10

Table 3: Summary Statistics – Innovation

This table provides summary statistics for variables used to predict the firm innovation. P(Overconfident-Male)-top 5 is the proportion of the top 5 executives who are overconfident males. P(Overconfident-Female)-top 5 is the proportion of the top 5 executives who are overconfident females. P(Non-Overconfident-Female)-top 5 is the proportion of the top 5 executives who are female and not overconfident. I(Overconfident-Male)-CEO is an indicator for an overconfident male CEO. I(Overconfident-Female)-CEO is an indicator for an overconfident female CEO. I(Non-Overconfident-Female)-CEO is an indicator for a non-overconfident female CEO. Patent Count is the total number of patents applied for during the year. Citation Count is the total number of citations summed across all patents applied for during the year. TTcitation is the total number of citations divided by the average citation count of all patents in the same technology class and applied in the same year. Qcitation is the total number of citations multiplied by the weighting index from Hall, Jaffe, and Trajtenberg (2001, 2005). Patent Quality is the number of patents applied for during the year. Patent Value-Nominal is the value of innovation in millions of nominal dollars. Patent Value-Real is the value of innovation in millions of real dollars deflated using CPI. Sales is firm sales (in millions)

PPE/EMP is net property, plant, and equipment (in thousands) per employee. Stock Return is buy-and-hold return over the fiscal year. Tenure-CEO is the tenure (in years) of the CEO. Delta-top 5 is the dollar change (in thousands) in executive's stock and option portfolio for 1% change in stock price averaged across the top 5 executives. Vega-top 5 is the dollar change (in thousands) in executive's options holdings for 1% change in stock price averaged across the top 5 executives. Institutional Ownership is the percentage of shares held by financial institutions, averaged over the fiscal year.

Statistic	N	Mean	St. Dev.	25%	Median	75%
P(Overconfident-Male)-top 5	11,379	0.519	0.359	0.200	0.500	0.800
P(Overconfident-Female)-top 5	11,379	0.033	0.102	0	0	0
P(Non-Overconfident-Female)-top 5	11,379	0.037	0.103	0	0	0
I(Overconfident-Male)-CEO	11,379	0.667	0.471	0	1	1
I(Overconfident-Female)-CEO	11,379	0.021	0.144	0	0	0
I(Non-Overconfident-Female)-CEO	11,379	0.011	0.103	0	0	0
Patent Count	11,379	44.29	242	0	1	14
Citation Count	11,379	478.1	3,390	0	0	83
TTcitation	11,379	48.38	249	0	0	12.78
Qcitation	11,379	102.2	791	0	1	26.58
Patent Value – Nominal	11,379	1,562	6,558	0	2.320	270.9
Patent Value – Real	11,379	657.1	2,730	0	1.041	118.5
Sales	11,379	5,906	11,078	632.9	1,741	5,185
PPE/EMP	11,379	208.3	920.9	24.12	44.504	89.26
Stock Return	11,379	0.116	0.481	-0.152	0.070	0.301
Tenure-CEO	11,379	7.853	7.185	3	6	11
Delta-top 5	11,379	468.5	3,206	70.73	157.2	354.2
Vega-top 5	11,379	95.77	183.9	21.72	49.50	111.4
Institutional Ownership	11,379	0.663	0.210	0.521	0.654	0.805
P(Female)-Board	11,379	0.125	0.106	0	0.111	0.200
P(Independent)-Board	11,379	0.724	0.201	0.667	0.778	0.875
Board Size	11,379	9.018	2.172	7	9	10

Table 4: TMT Members and Managerial Ability

	(1)		(2)		(3)	
	% Significant	Average P-value	% Significant	Average P-value	% Significant	Average P-value
CEO	80.6%	0.005	72.7%	0.011	60.9%	0.013
CFO			61.4%	0.008	65.0%	0.009
Top-5 Exec					52.8%	0.014
Firm Fixed Effects	Yes		Yes		Yes	
Year Fixed Effects	Yes		Yes		Yes	
N	22,600		22,600		22,600	

Table 5: M&A Events

This table reports analysis of M&A deals. In Columns 1-3, the dependent variable is an indicator for a completed M&A deal. In Columns 4-6, the dependent variable is the total dollar value of M&A deals during the fiscal year. In Columns 7-9, the dependent variable is the total premium paid for completed M&A deals. P(Female)-top 5 is the proportion of the top 5 executives who are female. P(Overconfident-Female)-top 5 is the proportion of the top 5 executives who are overconfident females. P(Non-Overconfident-Female)-top 5 is the proportion of the top 5 executives who are female and not overconfident. P(Overconfident-Male)-top 5 is the proportion of the top 5 executives who are overconfident males. I(Overconfident-Male)-CEO is an indicator for an overconfident male CEO. I(Overconfident-Female)-CEO is an indicator for an overconfident female CEO. I(Non-Overconfident-Female)-CEO is an indicator for a non-overconfident female CEO. Size is log of total assets. Q is the market value of assets scaled by the book value of assets. Cash Flow is earnings before extraordinary items and depreciation scaled by total assets. Debt is current plus long-term debt scaled by total assets. R&D is research and development scaled by sales. Total Stock Ownership-top 5 is the total number of shares held by the top 5 executives scaled by the total number of shares outstanding. Total Vested Options-top 5 is the total number of vested options held by the top 5 executives scaled by the total number of shares outstanding multiplied by ten to match the scaled of Total Stock Ownership-top 5. Board Size is the log of the total number of board members. P(Female)-Board is the proportion of board members that are female. P(Independent)-Board is the proportion of independent board members. Age-CEO is the age of the CEO. Tenure-CEO is the CEO's tenure with the firm. Coefficients are average marginal effects. P-values are shown in parenthesis.

Dependent Variable:	Completed	Completed	Completed	Dollar Value	Dollar Value	Dollar Value	M&A Premium	M&A Premium	M&A Premium
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
P(Female)-top 5	-0.135*** (0.005)			-0.250*** (0.010)			-22.296*** (0.003)		
P(Overconfident)-top 5	0.09*** (0.000)			0.171*** (0.000)			9.807 (0.418)		
P(Overconfident-Female)-top 5		0.013 (0.855)	0.035 (0.623)		0.026 (0.952)	0.039 (0.772)		29.846 (0.456)	22.575 (0.716)
P(Non-Overconfident-Female)-top 5		-0.188*** (0.006)	-9.006*** (0.001)		-0.852** (0.031)	-15.497*** (0.001)		-76.262** (0.044)	1296.163 (0.610)
P(Overconfident-Male)-top 5		0.084*** (0.000)	0.097*** (0.000)		0.487*** (0.000)	0.181*** (0.000)		6.041 (0.524)	10.969 (0.379)
Size	0.057*** (0.000)	0.055*** (0.000)	-0.060 (0.108)	0.130*** (0.000)	0.531*** (0.000)	-0.066 (0.318)	-0.216 (0.978)	-1.168 (0.728)	16.518 (0.620)
Q	0.003 (0.478)	-0.001 (0.766)	-0.043*** (0.002)	0.005 (0.643)	0.033 (0.282)	-0.069*** (0.005)	-0.164 (0.941)	-4.737** (0.011)	5.625 (0.649)
Cash Flow	0.165** (0.048)	0.134 (0.108)	0.074 (0.384)	0.130 (0.380)	0.148 (0.751)	0.022 (0.886)	53.607 (0.189)	33.591 (0.428)	58.228 (0.187)

Debt	0.051 (0.292)	0.061 (0.209)	0.137** (0.014)	0.146 (0.119)	0.681** (0.021)	0.301*** (0.004)	17.307 (0.567)	10.414 (0.548)	-3.370 (0.936)
R&D	-0.000 (0.995)	-0.008 (0.835)	-0.036 (0.322)	0.009 (0.839)	0.034 (0.807)	-0.050 (0.295)	-0.383 (0.986)	-38.523 (0.328)	5.034 (0.839)
Total Stock Ownership-top 5	-0.281 (0.344)	-0.301 (0.314)	-0.580* (0.058)	-0.473 (0.358)	-1.036 (0.527)	-1.032* (0.057)	-7.007 (0.975)	-257.039* (0.072)	43.019 (0.858)
Total Vested Options-top 5	-0.158 (0.793)	-0.097 (0.873)	1.554** (0.037)	0.079 (0.942)	-0.429 (0.902)	2.695** (0.048)	183.176 (0.632)	-109.829 (0.695)	-104.259 (0.859)
Board Size	-0.004** (0.011)	-0.005*** (0.003)	-0.015*** (0.000)	-0.008*** (0.008)	-0.028*** (0.005)	-0.027*** (0.000)	-0.544 (0.621)	0.092 (0.903)	1.385 (0.684)
P(Female)-Board	-0.034 (0.394)	-0.036 (0.368)	0.101* (0.069)	-0.054 (0.478)	-0.264 (0.279)	0.164 (0.107)	-4.256 (0.861)	-21.281 (0.234)	-22.173 (0.605)
P(Independent)-Board	-0.113 (0.211)	-0.116 (0.200)	0.176 (0.163)	-0.177 (0.304)	-0.545 (0.316)	0.310 (0.180)	-7.706 (0.883)	-59.831 (0.139)	-59.410 (0.544)
Age-CEO	0.051 (0.352)	0.065 (0.229)	0.113* (0.059)	0.006 (0.956)	0.153 (0.643)	0.164 (0.150)	39.330 (0.246)	-34.399 (0.176)	30.937 (0.465)
Tenure-CEO	-0.002 (0.179)	-0.002* (0.059)	-0.005*** (0.000)	-0.004* (0.078)	-0.012* (0.068)	-0.009*** (0.001)	0.393 (0.573)	0.426 (0.430)	0.926 (0.424)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8,141	8,141	8,598	8,141	8,141	8,141	1,143	1,143	1,143

Table 6: M&A Characteristics and Performance

This table reports analysis of M&A deals. In Columns 1 and (2), the dependent variable is an indicator for a completed M&A deal in which the target firm operates in a different (same) industry. In Columns 3 and (4), the dependent variable is a completed M&A deal in which the payment was cash only (other payment method). In Columns 5-6, the dependent variable is the 3-day cumulative abnormal return around a completed M&A deal. In Columns 7-8 the dependent variable is the change in industry-adjusted ROA. P(Female)-top 5 is the proportion of the top 5 executives who are female. P(Overconfident-Female)-top 5 is the proportion of the top 5 executives who are overconfident females. P(Non-Overconfident-Female)-top 5 is the proportion of the top 5 executives who are female and not overconfident. P(Overconfident-Male)-top 5 is the proportion of the top 5 executives who are overconfident males. I(Overconfident-Male)-CEO is an indicator for an overconfident male CEO. I(Overconfident-Female)-CEO is an indicator for an overconfident female CEO. I(Non-Overconfident-Female)-CEO is an indicator for a non-overconfident female CEO. Size is log of total assets. Q is the market value of assets scaled by the book value of assets. Cash Flow is earnings before extraordinary items and depreciation scaled by total assets. Debt is current plus long-term debt scaled by total assets. R&D is research and development scaled by sales. Total Stock Ownership-top 5 is the total number of shares held by the top 5 executives scaled by the total number of shares outstanding. Total Vested Options-top 5 is the total number of vested options held by the top 5 executives scaled by the total number of shares outstanding multiplied by ten to match the scaled of Total Stock Ownership-top 5. Board Size is the log of the total number of board members. P(Female)-Board is the proportion of board members that are female. P(Independent)-Board is the proportion of independent board members. Age-CEO is the age of the CEO. Tenure-CEO is the CEO's tenure with the firm. Coefficients are average marginal effects. P-values are shown in parenthesis.

Dependent Variable:	Inter-Industry M&A	Intra-Industry M&A	Cash Only	Other Payment Method	3-Day CAR	3-Day CAR	Change in Industry-Adjusted ROA	Change in Industry-Adjusted ROA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Inter-Industry M&A	Intra-Industry M&A	Inter-Industry M&A	Intra-Industry M&A
P(Overconfident-Female)-top 5	-0.129 (0.164)	0.039 (0.602)	0.112 (0.262)	0.024 (0.835)	0.239 (0.293)	0.023 (0.657)	0.246 (0.423)	0.108 (0.141)
P(Non-Overconfident-Female)-top 5	-0.272*** (0.001)	-0.111 (0.134)	0.031 (0.785)	-0.240 (0.154)	-0.085 (0.769)	0.007 (0.860)	0.396 (0.318)	0.118** (0.041)
P(Overconfident-Male)-top 5	0.132*** (0.000)	0.063*** (0.003)	0.049 (0.141)	0.100*** (0.010)	0.008 (0.850)	0.010 (0.368)	-0.087 (0.117)	0.022 (0.132)
P(Overconfident-Female)-top 5 * I(Below Industry Q)			-0.262* (0.052)	-0.085 (0.554)				
P(Non-Overconfident-Female)-top 5 * I(Below Industry Q)			-0.272** (0.028)	-0.038 (0.839)				
P(Overconfident-Male)-top 5 * I(Below Industry Q)			0.079** (0.034)	-0.011 (0.794)				
I(Below Industry Q)			-0.003 (0.924)	0.097*** (0.005)				
Cash Only					0.015 (0.393)	0.015** (0.021)	0.040* (0.092)	-0.004 (0.685)
Size	0.065*** (0.000)	0.073*** (0.000)	0.059*** (0.000)	0.075*** (0.000)	0.031 (0.347)	-0.015* (0.072)	-0.041 (0.370)	-0.011 (0.321)
Q	-0.003	0.005	-0.004	0.016***	-0.004	0.000	0.039	0.002**

	(0.575)	(0.379)	(0.548)	(0.002)	(0.831)	(0.602)	(0.104)	(0.045)
Cash Flow	0.067	0.149	0.279***	-0.028	0.445	-0.174***	0.164	-0.209***
	(0.460)	(0.116)	(0.003)	(0.738)	(0.267)	(0.002)	(0.762)	(0.007)
Debt	-0.053	0.078	-0.006	0.056	0.190	0.012	0.068	-0.048
	(0.383)	(0.124)	(0.908)	(0.313)	(0.141)	(0.733)	(0.692)	(0.332)
R&D	0.008	0.016	0.020	0.009	-0.213	0.043	0.840	-0.060
	(0.856)	(0.589)	(0.501)	(0.819)	(0.821)	(0.623)	(0.512)	(0.620)
Total Stock Ownership-top 5	-0.165	-0.267	-0.538*	0.012	1.909***	-0.113	-0.193	0.030
	(0.613)	(0.412)	(0.092)	(0.788)	(0.006)	(0.535)	(0.830)	(0.907)
Total Vested Options-top 5	-0.901	-0.006	-0.599	-0.141	-3.240*	-0.572	-0.451	-1.547***
	(0.223)	(0.992)	(0.357)	(0.174)	(0.088)	(0.153)	(0.858)	(0.006)
Board Size	-0.012	0.006	-0.016	-0.007	-0.028	-0.002	-0.072	0.011
	(0.790)	(0.887)	(0.709)	(0.909)	(0.485)	(0.855)	(0.192)	(0.442)
P(Female)-Board	-0.232**	-0.089	-0.176*	-0.144	0.066	-0.005	0.589**	0.018
	(0.027)	(0.347)	(0.054)	(0.165)	(0.722)	(0.921)	(0.023)	(0.789)
P(Independent)-Board	0.136**	-0.001	0.090	-0.007	0.014	0.030	-0.232	-0.010
	(0.038)	(0.984)	(0.118)	(0.908)	(0.903)	(0.315)	(0.132)	(0.816)
Age-CEO	-0.009***	-0.003	-0.004**	-0.008***	-0.001	0.000	0.003	-0.001
	(0.000)	(0.131)	(0.013)	(0.000)	(0.836)	(0.762)	(0.620)	(0.706)
Tenure-CEO	-0.001	-0.003**	-0.001	-0.002*	0.000	0.001**	-0.003*	0.002**
	(0.359)	(0.017)	(0.194)	(0.086)	(0.807)	(0.035)	(0.081)	(0.039)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	5,386	6,320	7,451	5,230	1,508	3,978	104	597

Table 7: Growth and Financing Decisions

This table reports analysis of asset growth and capital structure decisions following Huang and Kisgen (2013). In Columns 1-3, the dependent variable is the percentage change in total assets. In Columns 4-6, the dependent variable is the natural log of long-term debt issuance. In Columns 7-9, the dependent variable is the natural log of the sale of common and preferred stock. P(Female)-top 5 is the proportion of the top 5 executives who are female. P(Overconfident-Female)-top 5 is the proportion of the top 5 executives who are overconfident females. P(Non-Overconfident-Female)-top 5 is the proportion of the top 5 executives who are female and not overconfident. P(Overconfident-Male)-top 5 is the proportion of the top 5 executives who are overconfident males. I(Overconfident-Male)-CEO is an indicator for an overconfident male CEO. I(Overconfident-Female)-CEO is an indicator for an overconfident female CEO. I(Non-Overconfident-Female)-CEO is an indicator for a non-overconfident female CEO. Size is log of total assets. Q is the market value of assets scaled by the book value of assets. Cash Flow is earnings before extraordinary items and depreciation scaled by total assets. Debt is current plus long-term debt scaled by total assets. R&D is research and development scaled by sales. Total Stock Ownership-top 5 is the total number of shares held by the top 5 executives scaled by the total number of shares outstanding. Total Vested Options-top 5 is the total number of vested options held by the top 5 executives scaled by the total number of shares outstanding multiplied by ten to match the scaled of Total Stock Ownership-top 5. Board Size is the log of the total number of board members. P(Female)-Board is the proportion of board members that are female. P(Independent)-Board is the proportion of independent board members. Age-CEO is the age of the CEO. Tenure-CEO is the CEO's tenure with the firm. Coefficients are average marginal effects. P-values are shown in parenthesis.

Dependent Variable:	Asset Growth	Asset Growth	Asset Growth	Debt Issuance	Debt Issuance	Debt Issuance	Equity Issuance	Equity Issuance	Equity Issuance
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
P(Female)-top 5	0.039 (0.302)			-1.017 (0.297)			0.961 (0.117)		
P(Overconfident)-top 5	0.041* (0.072)			-0.090 (0.858)			0.589* (0.073)		
P(Overconfident-Female)-top 5		0.139*** (0.006)	0.919 (0.337)		2.004 (0.118)	-17.784 (0.462)		0.386 (0.662)	49.189*** (0.000)
P(Non-Overconfident-Female)-top 5		0.045 (0.350)	0.002 (0.933)		-3.105** (0.023)	-2.979*** (0.000)		0.166 (0.830)	-0.485 (0.219)
P(Overconfident-Male)-top 5		0.027 (0.167)	0.061*** (0.000)		0.087 (0.864)	0.022 (0.924)		0.941*** (0.005)	1.497*** (0.000)
Size	0.008 (0.570)	0.021** (0.036)	-0.010** (0.018)	1.356*** (0.000)	1.707*** (0.000)	2.370*** (0.000)	0.697** (0.013)	0.429* (0.086)	0.191*** (0.002)
Fixed Assets	0.005 (0.709)	0.016 (0.178)	0.005 (0.112)	0.485 (0.141)	0.868*** (0.009)	0.989*** (0.000)	0.026 (0.914)	-0.032 (0.896)	-0.015 (0.738)

Stock Return	0.057*** (0.000)	0.047*** (0.000)	0.117*** (0.000)	-0.336* (0.088)	-0.184 (0.437)	-0.072 (0.631)	0.402*** (0.000)	0.253** (0.024)	0.182** (0.033)
Ln(Delta)	0.056*** (0.000)	0.048*** (0.000)	0.032*** (0.000)	0.187 (0.296)	-0.093 (0.632)	-0.482*** (0.001)	0.760*** (0.000)	0.705*** (0.000)	0.345*** (0.000)
Ln(Vega)	-0.004 (0.652)	-0.006 (0.336)	-0.002 (0.618)	0.008 (0.956)	0.079 (0.631)	-0.136 (0.256)	0.183* (0.073)	0.153 (0.161)	0.674*** (0.000)
Tenure-CEO	-0.001 (0.843)	-0.002 (0.717)	-0.002*** (0.000)	0.165 (0.259)	0.265 (0.102)	0.021* (0.057)	-0.118 (0.221)	-0.127 (0.202)	-0.019*** (0.002)
Board Size	-0.004 (0.831)	0.006 (0.644)	0.019** (0.015)	-0.266 (0.393)	-0.531* (0.074)	-0.812*** (0.000)	0.975*** (0.000)	1.185*** (0.000)	1.808*** (0.000)
P(Female)-Board	-0.073 (0.129)	-0.040 (0.322)	-0.192* (0.095)	-2.392** (0.041)	-1.682 (0.164)	-0.880 (0.763)	-0.313 (0.664)	-0.254 (0.722)	-4.639*** (0.005)
P(Independent)-Board	-0.007 (0.922)	-0.018 (0.783)	-0.012 (0.600)	-0.919 (0.606)	-0.799 (0.654)	-1.169** (0.038)	-0.842 (0.423)	-0.188 (0.861)	0.898*** (0.005)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	14,260	14,260	14,592	14,260	14,260	14,592	14,260	14,260	14,592

Table 8: Firm Innovation

This table reports analysis of firm innovation. In Columns 1-3 the dependent variable is the natural log of one plus the total number of patents applied for in a given firm-year. In Columns 4-6 the dependent variable is the natural log of one plus Qcitation following Hall, Jaffe, and Trajtenberg (2001, 2005). In Columns 7-9 the dependent variable is the natural log of one plus the real dollar value of innovation in a given firm-year. P(Female)-top 5 is the proportion of the top 5 executives who are female. P(Overconfident-Female)-top 5 is the proportion of the top 5 executives who are overconfident females. P(Non-Overconfident-Female)-top 5 is the proportion of the top 5 executives who are female and not overconfident. P(Overconfident-Male)-top 5 is the proportion of the top 5 executives who are overconfident males. I(Overconfident-Male)-CEO is an indicator for an overconfident male CEO. I(Overconfident-Female)-CEO is an indicator for an overconfident female CEO. I(Non-Overconfident-Female)-CEO is an indicator for a non-overconfident female CEO. Size is log of total assets. Q is the market value of assets scaled by the book value of assets. Cash Flow is earnings before extraordinary items and depreciation scaled by total assets. Debt is current plus long-term debt scaled by total assets. R&D is research and development scaled by sales. Total Stock Ownership-top 5 is the total number of shares held by the top 5 executives scaled by the total number of shares outstanding. Total Vested Options-top 5 is the total number of vested options held by the top 5 executives scaled by the total number of shares outstanding multiplied by ten to match the scaled of Total Stock Ownership-top 5. Board Size is the log of the total number of board members. P(Female)-Board is the proportion of board members that are female. P(Independent)-Board is the proportion of independent board members. Age-CEO is the age of the CEO. Tenure-CEO is the CEO's tenure with the firm. Coefficients are average marginal effects. P-values are shown in parenthesis.

Dependent Variable:	Log(1+Patents)	Log(1+Patents)	Log(1+Patents)	Log(1+Qcitation)	Log(1+Qcitation)	Log(1+Qcitation)	Log(1+Patent Value - Real)	Log(1+Patent Value - Real)	Log(1+Patent Value - Real)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
P(Female)-top 5	0.120** (0.035)			0.075** (0.012)			0.195** (0.040)		
P(Overconfident)-top 5	0.059** (0.018)			0.113* (0.099)			0.196*** (0.000)		
P(Overconfident-Female)-top 5		0.276*** (0.001)	4.168** (0.026)		0.318*** (0.002)	4.491** (0.045)		0.569*** (0.000)	6.436** (0.039)
P(Non-Overconfident-Female)-top 5		0.048 (0.493)	0.032 (0.659)		0.017 (0.839)	-0.005 (0.952)		0.063 (0.593)	0.033 (0.780)
P(Overconfident-Male)-top 5		0.047* (0.072)	0.044* (0.096)		0.059* (0.058)	0.052 (0.105)		0.173*** (0.000)	0.168*** (0.000)
Size	0.300*** (0.000)	0.300*** (0.000)	0.308*** (0.000)	0.301*** (0.000)	0.301*** (0.000)	0.311*** (0.000)	0.550*** (0.000)	0.549*** (0.000)	0.557*** (0.000)
Fixed Assets	0.046** (0.010)	0.046** (0.011)	0.032* (0.088)	0.054** (0.012)	0.053** (0.013)	0.042* (0.060)	0.034 (0.251)	0.034 (0.258)	0.010 (0.757)

Stock Return	-0.002 (0.895)	-0.002 (0.858)	0.001 (0.940)	-0.000 (0.999)	-0.000 (0.976)	0.003 (0.863)	0.030 (0.170)	0.029 (0.179)	0.034 (0.151)
Institutional Ownership	-0.036 (0.325)	-0.037 (0.315)	-0.029 (0.460)	-0.049 (0.269)	-0.050 (0.262)	-0.032 (0.490)	-0.115* (0.063)	-0.116* (0.060)	-0.087 (0.176)
Ln(Delta)	0.010 (0.379)	0.011 (0.313)	-0.016 (0.356)	0.023* (0.091)	0.024* (0.079)	-0.005 (0.794)	0.091*** (0.000)	0.092*** (0.000)	0.056** (0.049)
Ln(Vega)	0.005 (0.564)	0.005 (0.558)	0.019 (0.103)	-0.001 (0.898)	-0.001 (0.934)	0.013 (0.369)	-0.017 (0.254)	-0.017 (0.262)	0.004 (0.820)
Tenure-CEO	0.000 (0.863)	-0.006 (0.541)	0.002 (0.258)	-0.002 (0.228)	-0.021* (0.064)	-0.000 (0.851)	-0.000 (0.854)	-0.012 (0.447)	0.002 (0.532)
Board Size	-0.024 (0.617)	0.360*** (0.000)	-0.012 (0.810)	-0.062 (0.292)	0.451*** (0.000)	-0.052 (0.391)	-0.168** (0.040)	0.620*** (0.000)	-0.168** (0.045)
P(Female)-Board	0.366*** (0.000)	-0.086 (0.115)	0.212* (0.096)	0.457*** (0.000)	-0.069 (0.286)	0.280* (0.067)	0.630*** (0.000)	-0.143 (0.115)	0.368* (0.084)
P(Independent)-Board	-0.089 (0.103)	-0.026 (0.593)	-0.071 (0.201)	-0.074 (0.257)	-0.064 (0.271)	-0.054 (0.414)	-0.147 (0.105)	-0.170** (0.037)	-0.128 (0.165)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	11,379	11,379	10,969	11,379	11,379	10,969	11,379	11,379	10,969

Table 9: Firm Innovation

This table reports analysis of firm innovation. In Column 1 the dependent variable is the natural log of one plus the total number of patents applied for in a given firm-year. In Column 2 the dependent variable is the natural log of one plus Qcitation following Hall, Jaffe, and Trajtenberg (2001, 2005). In Column 3 the dependent variable is the natural log of one plus the real dollar value of innovation in a given firm-year. P(Female)-top 5 is the proportion of the top 5 executives who are female. P(Overconfident-Female)-top 5 is the proportion of the top 5 executives who are overconfident females. P(Non-Overconfident-Female)-top 5 is the proportion of the top 5 executives who are female and not overconfident. P(Overconfident-Male)-top 5 is the proportion of the top 5 executives who are overconfident males. I(Overconfident-Male)-CEO is an indicator for an overconfident male CEO. I(Overconfident-Female)-CEO is an indicator for an overconfident female CEO. I(Non-Overconfident-Female)-CEO is an indicator for a non-overconfident female CEO. Size is log of total assets. Q is the market value of assets scaled by the book value of assets. Cash Flow is earnings before extraordinary items and depreciation scaled by total assets. Debt is current plus long-term debt scaled by total assets. R&D is research and development scaled by sales. Total Stock Ownership-top 5 is the total number of shares held by the top 5 executives scaled by the total number of shares outstanding. Total Vested Options-top 5 is the total number of vested options held by the top 5 executives scaled by the total number of shares outstanding multiplied by ten to match the scaled of Total Stock Ownership-top 5. Board Size is the log of the total number of board members. P(Female)-Board is the proportion of board members that are female. P(Independent)-Board is the proportion of independent board members. Age-CEO is the age of the CEO. Tenure-CEO is the CEO's tenure with the firm. Coefficients are average marginal effects. P-values are shown in parenthesis.

Dependent Variable:	Log(1+Patents)	Log(1+Qcitation)	Log(1+Patent Value - Real)
	(1)	(2)	(3)
P(Overconfident-Female)-top 5	0.005 (0.947)	0.052 (0.555)	-0.025 (0.874)
P(Non-Overconfident-Female)-top 5	0.114* (0.087)	0.142* (0.088)	0.180 (0.279)
P(Overconfident-Male)-top 5	-0.060* (0.066)	-0.060 (0.123)	-0.113 (0.116)
P(Overconfident-Female)-top 5 * I(Innovative Industry)	0.406*** (0.000)	0.403*** (0.004)	0.890*** (0.000)
P(Non-Overconfident-Female)-top 5 * I(Innovative Industry)	-0.117 (0.289)	-0.210 (0.111)	-0.225 (0.303)
P(Overconfident-Male)-top 5 * I(Innovative Industry)	0.143*** (0.000)	0.161*** (0.001)	0.384*** (0.000)
I(Innovative Industry)	0.084*** (0.007)	0.155*** (0.000)	0.192*** (0.004)
Size	0.303*** (0.000)	0.305*** (0.000)	0.558*** (0.000)
Fixed Assets	0.048** (0.015)	0.057** (0.017)	0.040 (0.190)
Stock Return	-0.001 (0.962)	0.002 (0.886)	0.034* (0.086)
Institutional Ownership	-0.041 (0.256)	-0.055 (0.203)	-0.125** (0.034)

Ln(Delta)	0.012 (0.323)	0.024* (0.077)	0.093*** (0.000)
Ln(Vega)	0.006 (0.520)	0.000 (0.981)	-0.015 (0.315)
Tenure-CEO	-0.006 (0.543)	-0.021* (0.074)	-0.013 (0.459)
Board Size	0.383*** (0.001)	0.479*** (0.000)	0.678*** (0.000)
P(Female)-Board	-0.087 (0.127)	-0.073 (0.303)	-0.147 (0.144)
P(Independent)-Board	-0.029 (0.587)	-0.069 (0.276)	-0.177** (0.040)
Firm F.E.	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes
N	11,379	11,379	11,379

Appendix A: Variable Description

Variable	Description
I(Overconfident-Male)-CEO	Indicator for firm-year in which the CEO is an overconfident male
I(Overconfident-Female)-CEO	Indicator for firm-year in which the CEO is an overconfident female
I(Non-Overconfident-Female)-CEO	Indicator for firm-year in which the CEO is a non-overconfident female
I(Overconfident-Male)-top 5	Indicator that equals one if there is at least one overconfident non-CEO male executive in the top five executives for a given firm-year
I(Female)-top 5	Indicator that equals one if there is at least one non-CEO female executive in the top five executives for a given firm-year
I(Overconfident-Female)-top 5	Indicator that equals one if there is at least one overconfident non-CEO female executive in the top five executives for a given firm-year
I(Non-Overconfident-Female)-top 5	Indicator that equals one if there is at least one non-CEO female executive who is not overconfident in the top five executives for a given firm-year
P(Overconfident-Male)-top 5	The proportion of non-CEO executives that are overconfident males
P(Female)-top 5	The proportion of non-CEO executives that female
P(Overconfident-Female)-top 5	The proportion of non-CEO executives that are overconfident females
P(Non-Overconfident-Female)-top 5	The proportion of non-CEO executives that are female and not overconfident
P(Non-Overconfident-Female-Connection)-Board	The proportion of board members that have had a positive experience with a non-overconfident female while serving on the board of another firm
N(Female)-Higher Education	The total number of females who have earned a master's degree or above in the state that the firm is incorporated in
I(M&A Deal)	Indicator for a successful merger or acquisition for any given firm-year
Total(M&A Number)	The total number of successful M&As per firm-year
Total(M&A Dollar Amount)	Total dollar amount (in millions) spent on successful M&A bids per firm-year
Premium Paid	Deal value scaled by target firm's EBITDA
Patent Count	Number of patents applied for during the year
Citation Count	Total number of citations summed across all patents applied for during the year.
TTcitation	Total number of citations summed across all patents applied for during the year. Each patent's number of citations is divided by the average citation count of all patents in the same technology class and applied in the same year.
Qcitation	Total number of citations summed across all patents applied for during the year. Each patent's number of citations is multiplied by the weighting index from Hall, Jaffe, and Trajtenberg (2001, 2005).
Patent Quality	Average number of citations per patent summed across all patents granted during the year
Patent Value – Nominal	Value of innovation in millions of nominal dollars
Patent Value – Real	Value of innovation deflated to 1982 (million) dollars using the CPI

Size	Log of firm's total assets
Q	Ratio of market value to book value
Cash Flow	Earnings before extraordinary items plus depreciation
Sales	Firm sales (in millions)
PPE/EMP	Net property, plant, and equipment (in thousands) per employee
Stock Return	Buy-and-hold return over the fiscal year
Debt	Current plus long-term debt scaled by total assets.
R&D	Research and development scaled by sales
Total Stock Ownership-top 5	Stock ownership of top five highest compensated executives as percent of shares outstanding
Total Vested Options-top 5	Total dollar amount of vested options held by top 5 highest compensated executives scaled by common shares outstanding, and multiplied by 10 to match same scale as Total Stock Ownership-top 5
Delta – top 5	Dollar change (in thousands) in executive's stock and option portfolio for 1% change in stock price averaged across the top 5 executives
Vega – top 5	Dollar change (in thousands) in executive's options holdings for 1% change in stock price averaged across the top 5 executives
Age-top 5	Average age of the top 5 executives
Tenure-CEO	Tenure of the CEO
Board Size	Natural log of the total number of members on the board of directors
P(Female)-Board	Proportion of the board of directors made up of females
P(Independent)-Board	Proportion of independent appointments on the board of directors
Institutional Ownership	Percentage of shares held by financial institutions, averaged over the fiscal year