Executive Gender and Overconfidence: The Effect on Firm Risk-Taking

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Abstract

I study the combined influence of two executive personal characteristics, overconfidence and gender, in two important yet meaningfully distinct contexts: investments in external (M&A) and internal (innovation) risky projects. 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. Lower investment in M&A deals by female executives is driven entirely by non-overconfident executives; overconfident female executives do not differ materially from their male counterparts. On the other hand, 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, largely regardless of holding 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.

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.

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, particularly as it relates to particularly high-potential-risk investments, such as investing in innovation 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 Puncochaf, 1994), treat the two as highly 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.

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 two firm actions for which each characteristic has been independently shown to be relevant: firm innovation and M&A activity. 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.[1] I find that overconfidence and gender are neither independent nor perfectly overlap, and their combined effect depends on context. In M&A deals, non-OC female executives drive the observed lower propensity to engage in M&As, but also leads to more long-term positive performance in completed deals. We find this effect primarily for non-CEO female executives. In the context of internal innovation, I find that both overconfident male and female executives produce greater innovation than their non-OC counterparts, but this is particularly strong (at nearly 5x the effect) for female executives. The effect is also more pervasive across the hierarchy, as we find that overconfidence also influences male executives' decision-making when they are CEO, but impacts the innovative activity for female executives whether they are CEO or a non-CEO executive. My findings offer a more nuanced and detailed view of how these characteristics impact executive decision-making.

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

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[1] 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. While this difference may not at first glance appear critical, it allows for a more robust analysis of executives further split into groups based on overconfidence.

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 a 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. 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 (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.[2] 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)

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

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.

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 (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(Overconfident-Male)-CEO, I(Overconfident-Female)-CEO, and I(Non-Overconfident-Female)-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(Overconfident-Male)-top 5, P(Overconfident-Female)-top 5, and P(Non-

Overconfident-Female)-top 5 are metrics denoting the proportion of overconfident male, overconfident female, and non-overconfident female executives, respectively.[3]

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(M&A)-Deal that indicates that the firm had at least one successful merger or acquisition bid in a given year. For robustness, I define Total(M&A Number) as the total number of mergers and acquisitions that were completed in a given year and Total(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 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.

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[3] 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(Overconfident-Female)-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.

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 TTcitation 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, Qcitation represents the collective 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, executive 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.

Turing 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 – M&A Activity

In this section, I summarize my empirical analysis that explores the connection between the overconfidence and gender characteristics of the C-suite and corporate risk-taking. Unlike related literature, I allow within-gender variation with respect to overconfidence. I conjecture that overconfidence and gender are jointly predictive of firm outcomes regarding decision-making and firm risk-taking. First, I examine these dynamics in the context of the firm's M&A strategy. I then study the join impact that executive overconfidence and gender have on the firm's propensity to innovate.

3.1.   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 the general form:

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

Where equation (1) is estimated in a logistic regression. 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. 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(Overconfident-Female-top 5) is the proportion of the top 5 executives that are overconfident females).

3.1.1. Predicting M&As

Table 4 reports the results predicting M&A events based on the proportion of executives in each group.[4] First, in column (1) I test the effect that female executives and overconfident executives have on M&A activity, separately. In essence, I am testing Hirshleifer et al. (2012) and Huang and Kisgen (2013) jointly. Consistent with related literature, I find that female executives are associate with significant reduction in M&A activity while overconfident executives are associate with a significant increase in M&A activity. That is, the results from Hirsheleifer et al. (2012) and Huang and Kisgen (2013) hold, while controlling for one another. Next, in column (2), I explicitly test whether or not overconfident female executives have a different effect on M&A activity compared to non-overconfident female executives by splitting P(Female)-top 5 into P(Overconfident-Female)-top 5 and P(Non-Overconfident-Female)-top 5. In doing so, 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, we cannot claim that female executives have a uniformly negative effect on M&A deals. Rather, the effect of female executives seems to be non-monotonic in overconfidence. Finally, I consider

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[4] P(Non-Overconfident-Male)-top5 is excluded from the analysis, and thus, serves as the baseline when interpreting the results.

the additional effect of overconfident men. In column (3), I find that firms with a higher proportion of overconfident men are significantly more acquisitive. 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. Interestingly, the negative effect that non-overconfident female executives have on the firm's M&A behavior remains significant after controlling for overconfident males. That is, this effect is not subsumed by the positive effect of overconfident males while considering the cumulative effect of multiple overconfident male executives[5].

One possible criticism of these findings 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. Specifically, one may argue that the magnitude of any potential CEO effect is larger than that of non-CEO executives. Thus, treating them all the same is not appropriate. For example, the finding the firms with a larger proportion of non-overconfident (and non-CEO) female executives may not hold for firms with an overconfident male CEO. In Table 5, 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%.

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, this finding adds to the evidence that shows that personal characteristics of the entire C-suite are consequential for firm outcomes, not just the CEO.[6]

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[5] 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.

[6] For robustness, in lieu of using I(M&A)-Deal to capture the firm's M&A activity, I repeat these tests on the total number of completed M&As as well as the total dollar amount (in millions of USD) spent on successful M&As in a given year. Results are consistent.

3.2.   Additional Tests

Following extant literature in this area, I perform several additional tests by examining several characteristics of merger and acquisition transactions. At least in part, the effects documented in Section 4.1 can be attributed to differences in risk-taking behavior. It follows that we would expect to see these differences manifest themselves across various M&A deal characteristics conditional on the relative risk associated with each. In other words, overconfidence and/or risk aversion may affect different types of M&As in distinctive ways and to varying degrees.

3.2.1.   Premium Paid

In this section I investigate the effect that executive overconfidence and gender characteristics have on the premium paid for M&A investments. 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 Table 6, I test the effect that executive overconfidence and gender characteristics have on premium paid using the total M&A deal value scaled by the target's EBITDA as a proxy. In doing so, I use a subsample of only completed mergers and acquisitions. In column (1) I find no significant relationship between female executives and premium paid after controlling for various firm characteristics, including the fraction of female directors. However, in column (2), I find a significant negative relationship between the proportion of non-overconfident female executives and premium paid, and no effect from overconfident female executives. Lastly, in column (3) I add the proportion of overconfident male executives and again find a significant negative effect from non-overconfident females. That is, firms with a larger proportion of non-overconfident female executives pay a lower premium when investing in M&As. Although firms with a larger proportion of non-overconfident female executives are less likely to acquire at all, once the firm

does decide to invest in M&A, non-overconfident females seem to reduce the premium the firm pays. Both findings are consistent with the theory that non-overconfident female executives tend to apply a larger discount rate when appraising prospective M&As, and in turn, estimate a smaller valuation relative to other executives, on average.

3.2.2.   Inter-industry M&A

In the M&A literature, it is common to distinguish diversifying from non-diversifying M&As. For example, Malmendier and Tate (2008) find that overconfident CEOs have a significant positive effect on diversifying M&As, but no effect on non-diversifying M&As. These authors argue this is an example of overconfident CEOs making value-destroying acquisitions because diversifying acquisitions are a proxy for value loss (i.e., the diversification discount). However, this label is a misnomer. In the context of personal finance and portfolio theory, diversifying implies risk reduction. On the other hand, in the context of M&A decisions, this is not necessarily the case. In other words, acquiring a target firm that operates in a different industry relative to the acquiring firm is not sufficient to guarantee a reduction in the overall risk of the acquiring firm. This is because, among other things, it boils down to the covariance of each firm's cash flows. Further, it is typical for the acquiring firm's managers to make significant changes to the target firm's management and overall business strategy. Because of this, post-merger cash flows generated from the target firm may look very different relative pre-acquisition cash flows. A more straightforward interpretation is that because overconfident executives overestimate their ability to generate large returns, they are more willing to step outside their expertise, for example, the industry classification of the firm's primary operations. 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.[7]

In columns (1) and (2) of Table 7, 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

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[7] 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.

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, after controlling for the effect of overconfident male executives. Thus, the main result discussed in the previous section is concentrated in inter-industry M&As. Turning to column (2) of Table 4, I find that non-overconfident female executives have no effect on intra-industry mergers and acquisitions.

3.2.3. *Payment Method*

Another M&A attribute to consider is the payment method. Malmendier and Tate (2008) show that firms led by overconfident CEOs are more likely to pay with cash when the firm is most likely to be perceived as overvalued by the market. They conjecture that this is because overconfident executives overvalue their own firms. In other words, from the overconfident executive's point of view, the market undervalues the firm enticing overconfident executives to pay with cash rather than equity or some other payment method.

In column (3) of Table 7, I report results predicting M&As in which the payment method was cash only. Results indicate that firm with a higher proportion of non-overconfident females tend to complete significantly less cash-only mergers and acquisitions when the firm's Q is below the industry standard.[8] In other words, during times when overconfident executives are most likely to perceive the firm as undervalued by the market. This result is consistent with what we would expect given previously documented differences between overconfident male executives and non-overconfident female executives.

3.2.4. *Post-M&A Performance*

Lastly, when studying mergers and acquisitions, it is natural to investigate the value implications 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

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[8] As an alternative test, I interact I(Below Industry Q) with all gender/overconfidence covariates. The results of this test are unreported due to multicollinearity issues.

resulting in value destruction. On the other hand, this is made more convoluted by the assertion that there is some optimal level of overconfidence for risk-averse executives. If this is the case, value implications of M&As are contingent on the firm's pre-merger investment strategy with respect to the optimal level. In other words, if the firm is already overinvesting, M&As completed by overconfident executives will be viewed negatively. Conversely, if the firm suffers from an underinvestment problem, M&As completed by overconfident executives will be viewed positively. Finally, 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 (1) and (2) of Table 8 reports results on the market's reaction to merger and acquisition announcements. I use a 3-day cumulative abnormal return (i.e., CAR) from a day before to a day after the event. Consistent with related literature, I test inter-industry and intra-industry M&As separately. I find that the overconfidence and gender characteristics of the firm's C-suite have no significant effect on the CAR surrounding the M&A announcement for both inter-industry and intra-industry deals. Due to the complex dynamics surrounding the market's reaction, I am agnostic about the interpretation of these results.

In addition to market reaction, it is important to investigate the long-run operating performance of the combined firm post-M&A. When examining operating performance, there is not the same potential for a gender bias from the market. Following nascent literature, 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 as I require there be non-missing data for each target firm's ROA pre-M&A. Results are displayed in columns (3) and (4) of Table 8. 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. Consistent with earlier findings, this suggests that, in addition to non-overconfident female executives reducing inter-industry M&A, the firm tends to benefit from M&As made completed by non-overconfident female executives in which the target is in the same industry as the acquirer.

4. Empirical Analysis and Results – Firm Innovation

4.1. Executive Overconfidence, Executive Gender, and Firm Innovation

This section presents my empirical findings, focusing on the nuanced relationship between executive overconfidence, executive gender, and the level of innovation within firms. Unique to this study is the nuanced approach that allows for within-gender variation in levels of overconfidence. I hypothesize that both gender and overconfidence serve as co-determinants of a firm's inclination towards innovation. More pointedly, the impact on innovation varies not only between male and female executives but also within these gender categories based on the degree of overconfidence exhibited.

My objective is to explore the interaction between executive overconfidence and gender at the firm level, examining the relationship of the C-suite's personal characteristics with the firm's innovation propensity, as indicated by its achievement of patents and citations. My empirical specification, therefore, takes the following general form:

$$(1) \ Innovation_{i,t} = f\big(Overconfidence \ \& \ Gender \ Characteristics_{i,t} + \\ Firm \ Characteristics_{i,t} + Executive \ Characteristics_{i,t} + \\ Board \ Characteristics_{i,t} + Ownership \ Characteristics_{i,t} + \\ Year \ Effect_t + Firm \ Effect_i\big)$$

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. $Firm \ Characteristics_{i,t}$ encompass 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, $Ownership\ Characteristics_{i,t}$ refer to institutional ownership, expressed as a percentage of total stockholder's equity.

4.1.1.　　　Patent and Citation Activity

To assess the divergent impacts of overconfident and non-overconfident female executives on firm innovation, I scrutinize patent acquisition and subsequent citations as proxies. I introduce firm-level variables capturing the C-suite's gender and confidence traits: specifically, P(Overconfident-Male)-Top 5, P(Overconfident-Female)-Top 5, and P(Non-Overconfident-Female)-Top 5.

Table 9 outlines the results. In column (1), the dependent variable is the natural logarithm of one plus the total number of patents applied for in a given year that were eventually granted.[9] First, I find that firms with a larger proportion of overconfident male executives attain more patents; however, this finding is only significant at the 10% level. To test my first hypothesis explicitly, I examine the effects of overconfident and non-overconfident female executives separately. I find that non-overconfident female executives have no significant effect on a firm's propensity to attain patents. Conversely, firms with a larger proportion of overconfident female executives attain significantly more patents, even after controlling for the effect of overconfident male executives and other determinants of firm innovation.

Next, I investigate the firm's propensity to attain citations on their patents, with the results shown in columns (2) and (3) of Table 9. Firms with a larger proportion of overconfident female executives attain significantly more patent citations after adjusting for truncation bias. In columns (4) and (5), I use total nominal value and total real value as dependent variables, respectively. Firms with a larger proportion of

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[9] Patents applied for but never granted are not included in the sample. Using the year in which the firm applied for the patent is a more accurate measure of current innovation activity compare to using the year in which the patent was eventually granted.

overconfident female executives achieve significantly higher returns in the form of total value from patents, supplementing the positive effect from overconfident male executives. Economically speaking, adding a single overconfident female to the C-suite results in an increase roughly three times that of adding an overconfident male executive. This finding is significant at the 1% level across all proxies for firm innovation.

While Table 9 assumes equal decision-making power among all C-suite members, the role of the CEO is notably distinct. CEOs wield greater influence, particularly in shaping the firm's innovation strategies. Hirshleifer et al. (2012) substantiate this by showing that overconfident CEOs significantly drive innovation. Therefore, it is crucial to examine the CEO's impact separately. In Table 10 I consider differential effects between the CEO and the rest of the C-suite.[10] Interestingly, consistent with related literature, I find that overconfident CEOs have a pronounced positive effect on firm innovation across all innovation proxies. Turning to my variables interest, I find that firms with a greater proportion of overconfident female executives are associated with increased innovative activities across all five proxies for innovation in addition to, and independent of, the CEO. 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.[11]

Together, these results substantiate my hypothesis that overconfidence serves as a distinguishing factor in the impact of female executives on firm innovation. Specifically, firms with a greater proportion of overconfident female executives not only exhibit enhanced innovation but also realize tangible value from such innovative activities. Conversely, non-overconfident female executives do not yield a significant influence on innovation outcomes. Interestingly, these effects are independent of, and in addition to the positive impact of overconfident male executives – especially an overconfident male CEO. Lastly, after

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[10] P(Overconfident-Male)-top 5, P(Overconfident-Female)-top 5 and P(Non-Overconfident-Female)-top 5 only include the non-CEO C-suite members in the top 4 non-CEO members.

[11] 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.

controlling for the proportion of female board members—a factor previously linked to increased firm innovation in the literature (Chen, Lueng, and Evans, 2018; Griffin, Li, and Xu, 2021)—I find that overconfident female executives still significantly contribute to greater innovation in their firms. This underscores the importance of considering individual risk-taking traits, like overconfidence, when evaluating the role of female executives in firm innovation, instead of treating all female executives as a homogenous group influenced solely by gender-based managerial styles.

4.1.2. Patent and Citation Activity for Firms in Innovative Industries

Building upon established literature, this subsection probes the nuanced interplay between executive overconfidence, gender, and firm innovation across firms in differing industries. Given that innovation often correlates with a higher appetite for risk, one might anticipate a more substantial influence of overconfident executives—regardless of gender—on firm innovation in industries with elevated levels of innovative activity. To distinguish between innovative and non-innovative industries, I employ a metric grounded in patent citation statistics. An industry is classified as innovative if its prior-year average Qcitation count per patent surpasses the median Qcitation count calculated across all industry categories. For the purposes of this categorization, industry classifications are based on their two-digit SIC codes.

To test this hypothesis, I interact all executive overconfidence and gender metrics with a binary variable indicating whether a firm is part of an innovative industry. Table 11 reports the results. Consistent with what we would expect, I find that the positive impact that overconfident female executives have on firm innovation is dominated by firms operating in innovative industries. Interestingly, column (2) also suggests that non-overconfident female executives are associated with a significantly reduced number of citations within these innovative industries, although this finding is only significant at 10%.

4.1.3. Patent Quality

To complement my analysis on the quantity of patents, this subsection scrutinizes their quality. Specifically, the quality is evaluated based on citations per patent (TTcitation and Qcitation) and the realized dollar value per patent. These additional measures allow for a more nuanced understanding of the multifaceted impact of executive traits on innovation. Results are outlined in Table 6A and 6B.

In Table 12, I find mixed results depending on the quality metric considered. For TTcitation per patent, overconfident executives—regardless of gender—have no significant effect. Interestingly, the presence of non-overconfident female executives is negatively associated with this measure, albeit only significantly at the 10% level. For Qcitation per patent, female executives—whether overconfident or not—do not significantly influence the metric, while overconfident male executives do, positively. Lastly, when assessing the real dollar value per patent, both overconfident male and overconfident female executives have a positive impact.

In Table 13 I examine the effects that executive overconfidence and gender have on patent quality in innovative vs. non-innovative industries. First, in column (1), I find that the negative effect that non-overconfident female executives have on TTcitation per patent is pronounced for firms in innovative industries. This finding is now significant at 5%. In column (2) I find that the positive impact that overconfident male executives have on Qcitation per patent is concentrated in innovative industries. Finally, in column (3) I find that the positive effect that both overconfident male and female executives have on patent value in real dollars per patent is driven by firms in innovative industries. These findings are consistent with the overarching idea that the impacts of executive overconfidence and gender, both of which influence risk-taking behavior, are most pronounced in firms within innovative industries. While previous sections focused on the quantity of innovation, this section substantiates that the quality of innovation is similarly influenced by these complex dynamics.

4.2.   *Instrumental Variables Approach*

In exploring the impact of executive overconfidence and gender on firm risk-taking in the form of M&A policy and innovation, endogeneity issues arise due to unobservable firm characteristics. Although I use year and firm fixed effects to control for time-invariant unobservable confounders, there may still be time-variant unobservable variables that affect both the firm's propensity to employ executives based on their overconfidence and gender characteristics as well as the firm's risk-taking strategies. That is, executives are not randomly assigned to firms. To address this concern, I use an instrumental variable that I adapt from Adams and Ferreira (2009). That is, I define my instrumental variable as the fraction of the

firm's board members who have had a positive experience with a non-overconfident female executive at another firm, at some point in the past. If a board member has a favorable experience working with a non-overconfident female executive, they are likely to want to work with other non-overconfident female executives in the future. This could manifest itself as board members hiring non-overconfident female executives or retaining existing ones. I define a favorable experience as one in which the firm was above the 75th percentile in terms of industry-adjusted Tobin's Q in that year. This instrumental variable is denoted P(Non-Overconfident-Female-Connection)-Board.

The endogenous variable that I instrument for is the proportion of non-overconfident female executives in the C-suite. This is the lone variable I consider with respect to executive overconfidence and gender characteristics. There is both a theoretical and a practical reason for this. First, because executives are not randomly assigned to firms, it follows that all overconfidence/gender variables are endogenous. By addressing non-overconfident female executives in isolation, I no longer have a concern for the proportion of overconfident male executives and the proportion of overconfident female executives. Second, all three of these variables are mechanically related to one another, by construction. That is, the proportion of overconfident male, overconfident female, non-overconfident male, and non-overconfident female executives must sum to one. Thus, a large proportion of overconfident female executives necessarily increases the likelihood of a small value for the proportion of non-overconfident female executives, for example. Because of this, the proportion of overconfident male executives and the proportion of overconfident female executives are extremely good predictors of the proportion of non-overconfident female executives regardless of the instrument(s) I employ. Hence, from a practical standpoint, if I include the proportion of overconfident male executives and the proportion of overconfident female executives in the 1st stage, the F-statistic will be inflated to a large degree.

Table 13 presents the results from predicting M&As using an instrumented value for the proportion of non-overconfident female executives. For the first stage, I use a tobit model with censoring at 0 and 1. First, results shown in column (1) indicate that my instrumental variable satisfies the relevance restriction. That is, that the fraction of board members who have had a favorable experience with a non-overconfident

female executive is a positive and significant predictor proportion of non-overconfident female executives. Further, in an unreported OLS specification, I calculate an F-statistic with a value of 12.7, alleviating some weak instrument concerns. For the second stage, I use a logit model to predict a binary variable indicating the firm completed at least one acquisition in that year. Results are consistent with the main result discussed in section 4.1. That is, using an instrumented value, I find that firms with a larger proportion of non-overconfident female executives are significantly less likely to invest in M&As. In Table 14, I repeat this instrumental variable specification on my primary tests relating executive overconfidence and gender and firm innovation. Column (1) reports results satisfying the relevance restriction. As we would expect, the proportion of the board of directors that has had a favorable experience with a non-overconfident female executive is a significant and negative predictor of the proportion of overconfident female executives. That is, a favorable experience with a non-overconfident female executive seems to dissuade the board of directors from employing an overconfident female executive at the focal firm. Further, the OLS F-stat for the first stage is 13.2 addressing concerns of a weak IV. Columns (2-5) confirm my finding that firms with a larger proportion of overconfident female executives tend to be better innovators.

5. 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 two important yet meaningfully distinct contexts: investments in external (M&A) and internal (innovation) risky projects. 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. 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. On the other hand, 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. This is distinct from the effect of overconfidence for male executives, which is only significant when the executive is the CEO. 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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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

Appendix B: Primary Analysis

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	Min	25%	Median	75%	Max	St. Dev.
P(Female)-top 5	8,141	0.065	0	0	0	0	1	0.135
P(Overconfident-Female)-top 5	8,141	0.033	0	0	0	0	1	0.100
P(Non-Overconfident-Female)-top 5	8,141	0.032	0	0	0	0	1	0.095
P(Overconfident-Male)-top 5	8,141	0.531	0	0.200	0.600	0.800	1	0.361
P(Non- Overconfident-Male)-top 5	8,141	0.404	0	0	0.400	0.750	1	0.358
I(Overconfident-Male)-CEO	8,141	0.702	0	0	1	1	1	0.458
I(Overconfident-Female)-CEO	8,141	0.018	0	0	0	0	1	0.133
I(Non-Overconfident-Female)-CEO	8,141	0.006	0	0	0	0	1	0.078
I(M&A Deal)	8,141	0.322	0	0	0	1	1	0.467
Total(M&A Number)	8,141	0.462	0	0	0	1	12	0.836
Total(M&A Dollar Amount)	8,141	403.9	0	0	0	61.6	79,406	2,495
Size	8,141	8.094	3.426	6.968	8.052	9.179	10.908	1.484
Q	8,141	2.149	0.445	1.284	1.703	2.417	37.772	1.557
Cash Flow	8,141	0.093	-1.385	0.062	0.094	0.133	0.359	0.088
Debt	8,141	0.261	0.000	0.137	0.257	0.361	3.892	0.202
R&D	8,141	0.058	0	0	0.008	0.053	17.444	0.274
Total Stock Ownership-top 5	8,141	0.016	0.0001	0.002	0.005	0.014	0.268	0.031
Total Vested Options-top 5	8,141	0.014	0.001	0.004	0.009	0.018	0.094	0.015
Age-top 5	8,141	53.781	34.500	51.000	54.000	56.667	80.000	4.635
Board Size	8,141	2.228	1.099	2.079	2.197	2.398	3.332	0.240
P(Female)-Board	8,141	0.136	0.000	0.071	0.125	0.200	0.625	0.107
P(Independent)-Board	8,141	0.689	0.000	0.625	0.778	0.875	1	0.255
Tenure-CEO	8,141	7.493	0	3	6	10	47	6.865

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-Feale)-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	Min	25%	Median	75%	Max	St. Dev.
P(Overconfident-Male)-top 5	11,379	0.519	0	0.200	0.500	0.800	1	0.359
P(Overconfident-Female)-top 5	11,379	0.033	0	0	0	0	1	0.102
P(Non-Overconfident-Female)-top 5	11,379	0.037	0	0	0	0	1	0.103
I(Overconfident-Male)-CEO	11,379	0.667	0	0	1	1	1	0.471
I(Overconfident-Female)-CEO	11,379	0.021	0	0	0	0	1	0.144
I(Non-Overconfident-Female)-CEO	11,379	0.011	0	0	0	0	1	0.103
Patent Count	11,379	44.29	0	0	1	14	8,890	242
Citation Count	11,379	478.1	0	0	0	83	130,331	3,390
TTcitation	11,379	48.38	0	0	0	12.78	7,147	249
Qcitation	11,379	102.2	0	0	1	26.58	42,719	791
Patent Value – Nominal	11,379	1,562	0	0	2.320	270.9	189,788	6,558
Patent Value – Real	11,379	657.1	0	0	1.041	118.5	63,866	2,730
Sales	11,379	5,906	0.317	632.9	1,741	5,185	53,370	11,078
PPE/EMP	11,379	208.3	0.361	24.12	44.504	89.26	10,022	920.9
Stock Return	11,379	0.116	-0.918	-0.152	0.070	0.301	8.948	0.481
Tenure-CEO	11,379	7.853	0.000	3	6	11	50	7.185
Delta-top 5	11,379	468.5	0.346	70.73	157.2	354.2	134,423	3,206
Vega-top 5	11,379	95.77	0	21.72	49.50	111.4	5,367	183.9
Institutional Ownership	11,379	0.663	0	0.521	0.654	0.805	1	0.210
P(Female)-Board	11,379	0.125	0	0	0.111	0.200	0.667	0.106
P(Independent)-Board	11,379	0.724	0	0.667	0.778	0.875	1	0.201
Board Size	11,379	9.018	4	7	9	10	23	2.172

Table 4: Predicting M&As – Completed Acquisitions

This table reports logistic regressions where the dependent variable is I(M&A Deal). 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. 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. Coefficients are average marginal effects. P-values are shown in parenthesis.

	(1)	(2)	(3)
P(Female)-top 5	-0.135***		
	(0.005)		
P(Overconfident)-top 5	0.09***		
	(0.000)		
P(Overconfident-Female)-top 5		-0.015	0.013
		(0.835)	(0.855)
P(Non-Overconfident-Female)-top 5		-0.252***	-0.188***
		(0.000)	(0.006)
P(Overconfident-Male)-top 5			0.084***
			(0.000)
Size	0.057***	0.055***	0.055***
	(0.000)	(0.000)	(0.000)
Q	0.003	0.002	-0.001
	(0.478)	(0.643)	(0.766)
Cash Flow	0.165**	0.162*	0.134
	(0.048)	(0.052)	(0.108)
Debt	0.051	0.053	0.061
	(0.292)	(0.270)	(0.209)
R&D	-0.000	-0.002	-0.008
	(0.995)	(0.955)	(0.835)
Total Stock Ownership-top 5	-0.281	-0.297	-0.301
	(0.344)	(0.319)	(0.314)
Total Vested Options-top 5	-0.158	-0.155	-0.097
	(0.793)	(0.797)	(0.873)
Age-top 5	-0.004**	-0.004***	-0.005***
	(0.011)	(0.010)	(0.003)
Board Size	-0.034	-0.034	-0.036
	(0.394)	(0.404)	(0.368)
P(Female)-Board	-0.113	-0.123	-0.116
	(0.211)	(0.172)	(0.200)
P(Independent)-Board	0.051	0.057	0.065
	(0.352)	(0.299)	(0.229)
Tenure-CEO	-0.002	-0.002	-0.002*
	(0.179)	(0.170)	(0.059)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	8,141	8,141	8,141

Table 5: Predicting M&A Events – Controlling for CEO Overconfidence and Gender Characteristics

This table reports logistic regressions where the dependent variable is I(M&A Deal). 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.

	(1)	(2)	(3)
P(Female)-top 5	-0.079**		
	(0.039)		
P(Overconfident-Female)-top 5		0.005	0.019
		(0.929)	(0.715)
P(Non-Overconfident-Female)-top 5		-0.157***	-0.141***
		(0.002)	(0.007)
P(Overconfident-Male)-top 5			0.034*
			(0.054)
I(Overconfident-Male)-CEO	0.046***	0.042**	0.033*
	(0.005)	(0.010)	(0.051)
I(Overconfident-Female)-CEO	0.065	0.066	0.053
	(0.239)	(0.234)	(0.336)
I(Non-Overconfident-Female)-CEO	-0.005	-0.002	-0.009
	(0.949)	(0.984)	(0.909)
Size	0.062***	0.059***	0.059***
	(0.000)	(0.000)	(0.000)
Q	0.001	0.000	-0.001
	(0.806)	(0.945)	(0.820)
Cash Flow	0.178*	0.176*	0.167*
	(0.053)	(0.056)	(0.069)
Debt	0.054	0.055	0.059
	(0.273)	(0.271)	(0.231)
R&D	-0.082	-0.087	-0.089
	(0.305)	(0.282)	(0.274)
Total Stock Ownership-top 5	-0.207	-0.219	-0.224
	(0.506)	(0.481)	(0.473)
Total Vested Options-top 5	-0.242	-0.204	-0.220
	(0.714)	(0.758)	(0.740)
Board Size	-0.053	-0.053	-0.052
	(0.195)	(0.199)	(0.205)
P(Female)-Board	-0.148	-0.149	-0.140
	(0.108)	(0.107)	(0.130)
P(Independent)-Board	0.062	0.067	0.070
	(0.265)	(0.227)	(0.205)
Age-CEO	-0.003**	-0.003**	-0.003**
	(0.018)	(0.019)	(0.021)

Tenure-CEO	-0.001	-0.001	-0.001
	(0.520)	(0.525)	(0.481)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	8,141	8,141	8,141

Table 6: Premium Paid for M&As

This table reports OLS regressions where the dependent variable is the premium paid for M&As that I define as the M&A Deal Amount scaled by EBITDA. 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. 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. Coefficients are average marginal effects. P-values are shown in parenthesis.

	(1)	(2)	(3)
P(Female)-top 5	-29.448		
	(0.291)		
P(Overconfident)-top 5	10.832		
	(0.235)		
P(Overconfident-Female)-top 5		28.039	29.846
		(0.482)	(0.456)
P(Non-Overconfident-Female)-top 5		-81.442**	-76.262**
		(0.027)	(0.044)
P(Overconfident-Male)-top 5			6.041
			(0.524)
Size	-1.537	-1.177	-1.168
	(0.648)	(0.726)	(0.728)
Q	-4.373**	-4.548**	-4.737**
	(0.017)	(0.013)	(0.011)
Cash Flow	37.666	35.215	33.591
	(0.374)	(0.405)	(0.428)
Debt	11.605	10.430	10.414
	(0.504)	(0.547)	(0.548)
R&D	-39.569	-38.427	-38.523
	(0.316)	(0.329)	(0.328)
Total Stock Ownership-top 5	-249.333*	-247.514*	-257.039*
	(0.080)	(0.081)	(0.072)
Total Vested Options-top 5	-110.114	-105.243	-109.829
	(0.694)	(0.707)	(0.695)
Age-top 5	0.130	0.082	0.092
	(0.862)	(0.912)	(0.903)
Board Size	-24.492	-21.469	-21.281
	(0.170)	(0.230)	(0.234)
P(Female)-Board	-55.598	-60.933	-59.831
	(0.168)	(0.131)	(0.139)
P(Independent)-Board	-36.759	-35.598	-34.399
	(0.147)	(0.160)	(0.176)
Tenure-CEO	0.473	0.471	0.426
	(0.378)	(0.379)	(0.430)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	1,143	1,143	1,143

Table 7: Predicting M&As – M&A Characteristics

This table reports logistic regressions where the dependent variable is I(M&A Deal). 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(Below Industry Q) indicates that firm Q was below industry-adjusted Q. 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. Coefficients are average marginal effects. P-values are shown in parenthesis

	Inter-Industry M&A	Intra-Industry M&A	Cash Only	Other Payment Method
P(Overconfident-Female)-top 5	-0.129	0.039	0.036**	-0.024
	(0.164)	(0.602)	(0.031)	(0.780)
P(Overconfident-Male)-top 5	0.132***	0.063***	0.103***	0.091***
	(0.000)	(0.003)	(0.000)	(0.000)
P(Non-Overconfident-Female)-top 5	-0.272***	-0.111	0.071	-0.253
	(0.001)	(0.134)	(0.521)	(0.124)
P(Non-Overconfident-Female)-top 5 * I(Below Industry Q)			-0.320**	-0.022
			(0.014)	(0.906)
Size	0.065***	0.073***	0.061***	0.075***
	(0.000)	(0.000)	(0.000)	(0.000)
Q	-0.003	0.005	-0.005	0.016***
	(0.575)	(0.379)	(0.451)	(0.001)
I(Below Industry Q)			0.036**	0.087***
			(0.031)	(0.000)
Cash Flow	0.067	0.149	0.284***	-0.028
	(0.460)	(0.116)	(0.003)	(0.742)
Debt	-0.053	0.078	-0.002	0.056
	(0.383)	(0.124)	(0.964)	(0.309)
R&D	0.008	0.016	0.021	0.009
	(0.856)	(0.589)	(0.491)	(0.814)
Total Stock Ownership-top 5	-0.165	-0.267	-0.542*	0.090
	(0.613)	(0.412)	(0.089)	(0.780)
Total Vested Options-top 5	-0.901	-0.006	-0.648	0.186
	(0.223)	(0.992)	(0.320)	(0.781)
Age-top 5	-0.009***	-0.003	-0.004**	-0.008***
	(0.000)	(0.131)	(0.018)	(0.000)
Board Size	-0.012	0.006	-0.017	0.012
	(0.790)	(0.887)	(0.684)	(0.796)
P(Female)-Board	-0.232**	-0.089	-0.181**	-0.144
	(0.027)	(0.347)	(0.048)	(0.165)
P(Independent)-Board	0.136**	-0.001	0.088	-0.007
	(0.038)	(0.984)	(0.118)	(0.908)
Tenure-CEO	-0.001	-0.003**	-0.002	-0.002*
	(0.359)	(0.017)	(0.162)	(0.084)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	5,386	6,320	7,451	5,230

Table 8: Post-M&A Firm Performance

This table reports logistic regressions where the dependent variable is I(M&A Deal). 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(Below Industry Q) indicates that firm Q was below industry-adjusted Q. 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. Coefficients are average marginal effects. P-values are shown in parenthesis

	3-Day CAR		Change in Industry-Adjusted ROA	
	Inter-Industry M&A	Intra-Industry M&A	Inter-Industry M&A	Intra-Industry M&A
P(Overconfident-Female)-top 5	0.239	0.023	0.246	0.108
	(0.293)	(0.657)	(0.423)	(0.141)
P(Overconfident-Male)-top 5	0.008	0.010	-0.087	0.022
	(0.850)	(0.368)	(0.117)	(0.132)
P(Non-Overconfident-Female)-top 5	-0.085	0.007	0.396	0.118**
	(0.769)	(0.860)	(0.318)	(0.041)
Cash Only	0.015	0.015**	0.040*	-0.004
	(0.393)	(0.021)	(0.092)	(0.685)
Size	0.031	-0.015*	-0.041	-0.011
	(0.347)	(0.072)	(0.370)	(0.321)
Q	-0.004	0.000	0.039	0.002**
	(0.831)	(0.602)	(0.104)	(0.045)
Cash Flow	0.445	-0.174***	0.164	-0.209***
	(0.267)	(0.002)	(0.762)	(0.007)
Debt	0.190	0.012	0.068	-0.048
	(0.141)	(0.733)	(0.692)	(0.332)
R&D	-0.213	0.043	0.840	-0.060
	(0.821)	(0.623)	(0.512)	(0.620)
Total Stock Ownership-top 5	1.909***	-0.113	-0.193	0.030
	(0.006)	(0.535)	(0.830)	(0.907)
Total Vested Options-top 5	-3.240*	-0.572	-0.451	-1.547***
	(0.088)	(0.153)	(0.858)	(0.006)
Age-top 5	-0.001	0.000	0.003	-0.001
	(0.836)	(0.762)	(0.620)	(0.706)
Tenure-CEO	0.000	0.001**	-0.003*	0.002**
	(0.807)	(0.035)	(0.081)	(0.039)
Board Size	-0.028	-0.002	-0.072	0.011
	(0.485)	(0.855)	(0.192)	(0.442)
P(Female)-Board	0.066	-0.005	0.589**	0.018
	(0.722)	(0.921)	(0.023)	(0.789)
P(Independent)-Board	0.014	0.030	-0.232	-0.010
	(0.903)	(0.315)	(0.132)	(0.816)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	1,508	3,978	104	597

Table 9: Executive Overconfidence, Gender, and Firm Innovation

This table reports results of OLS regressions using the overconfidence and gender characteristics of the C-suite to predict 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. 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. P-values are calculated using robust standard errors and are shown in parenthesis.

	Log(1+Patents)	Log(1+ TTcitation)	Log(1+ Qcitation)	Log(1+Patent Value - Nominal)	Log(1+Patent Value - Real)
P(Overconfident-Male)-top 5	0.047*	0.032	0.059*	0.193***	0.173***
	(0.072)	(0.292)	(0.058)	(0.000)	(0.000)
P(Overconfident-Female)-top 5	0.276***	0.317***	0.318***	0.633***	0.569***
	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)
P(Non-Overconfident-Female)-top 5	0.048	-0.076	0.017	0.087	0.063
	(0.493)	(0.365)	(0.839)	(0.529)	(0.593)
Log(Sales)	0.300***	0.266***	0.301***	0.603***	0.549***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(PPE/EMP)	0.046**	0.075***	0.053**	0.021	0.034
	(0.011)	(0.000)	(0.013)	(0.547)	(0.258)
Stock Return	-0.002	0.008	-0.000	0.034	0.029
	(0.858)	(0.618)	(0.976)	(0.187)	(0.179)
Log(1+Tenure-CEO)	-0.006	-0.037***	-0.021*	-0.011	-0.012
	(0.541)	(0.001)	(0.064)	(0.557)	(0.447)
Log(1+Delta-top 5)	0.011	0.022*	0.024*	0.097***	0.092***
	(0.313)	(0.096)	(0.079)	(0.000)	(0.000)
Log(1+Vega-top 5)	0.005	-0.004	-0.001	-0.022	-0.017
	(0.558)	(0.691)	(0.934)	(0.219)	(0.262)
Institutional Ownership	-0.037	-0.037	-0.050	-0.150**	-0.116*
	(0.315)	(0.399)	(0.262)	(0.038)	(0.060)
P(Female)-Board	0.360***	0.334***	0.451***	0.701***	0.620***
	(0.000)	(0.006)	(0.000)	(0.000)	(0.000)
P(Independent)-Board	-0.086	-0.039	-0.069	-0.187*	-0.143
	(0.115)	(0.544)	(0.286)	(0.079)	(0.115)
Log(Board Size)	-0.026	-0.048	-0.064	-0.189**	-0.170**
	(0.593)	(0.407)	(0.271)	(0.048)	(0.037)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	11,379	11,379	11,379	11,379	11,379
Adjusted R^2	0.912	0.893	0.901	0.883	0.906

Table 10: Executive Overconfidence, Gender, and Firm Innovation – Control for CEO characteristics

This table reports results of OLS regressions using the overconfidence and gender characteristics of the C-suite to predict 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. 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. P-values are calculated using robust standard errors and are shown in parenthesis.

	Log(1+Patents)	Log(1+ TTcitation)	Log(1+ Qcitation)	Log(1+Patent Value - Nominal)	Log(1+Patent Value - Real)
I(Overconfident-Male)-CEO	0.099***	0.066***	0.104***	0.226***	0.203***
	(0.000)	(0.006)	(0.000)	(0.000)	(0.000)
I(Overconfident-Female)-CEO	0.027	-0.020	0.029	0.221*	0.195*
	(0.692)	(0.801)	(0.720)	(0.095)	(0.085)
I(Non-Overconfident-Female)-CEO	-0.184**	-0.251***	-0.216**	-0.208	-0.201
	(0.024)	(0.009)	(0.027)	(0.190)	(0.138)
P(Overconfident-Male)-top 5	-0.022	-0.006	-0.012	0.039	0.037
	(0.297)	(0.826)	(0.643)	(0.358)	(0.296)
P(Overconfident-Female)-top 5	0.151**	0.202***	0.179**	0.393***	0.352***
	(0.013)	(0.005)	(0.014)	(0.001)	(0.001)
P(Non-Overconfident-Female)-top 5	0.025	-0.040	0.006	0.061	0.047
	(0.627)	(0.509)	(0.917)	(0.539)	(0.583)
Log(Sales)	0.300***	0.266***	0.301***	0.603***	0.549***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(PPE/EMP)	0.046**	0.075***	0.053**	0.021	0.034
	(0.011)	(0.000)	(0.013)	(0.547)	(0.258)
Stock Return	-0.002	0.008	-0.000	0.034	0.029
	(0.858)	(0.618)	(0.976)	(0.187)	(0.179)
Log(1+Tenure-CEO)	-0.006	-0.037***	-0.021*	-0.011	-0.012
	(0.541)	(0.001)	(0.064)	(0.557)	(0.447)
Log(1+Delta-top 5)	0.011	0.022*	0.024*	0.097***	0.092***
	(0.313)	(0.096)	(0.079)	(0.000)	(0.000)
Log(1+Vega-top 5)	0.005	-0.004	-0.001	-0.022	-0.017
	(0.558)	(0.691)	(0.934)	(0.219)	(0.262)
Institutional Ownership	-0.037	-0.037	-0.050	-0.150**	-0.116*
	(0.315)	(0.399)	(0.262)	(0.038)	(0.060)
P(Female)-Board	0.360***	0.334***	0.451***	0.701***	0.620***
	(0.000)	(0.006)	(0.000)	(0.000)	(0.000)
P(Independent)-Board	-0.086	-0.039	-0.069	-0.187*	-0.143
	(0.115)	(0.544)	(0.286)	(0.079)	(0.115)
Log(Board Size)	-0.026	-0.048	-0.064	-0.189**	-0.170**
	(0.593)	(0.407)	(0.271)	(0.048)	(0.037)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	11,379	11,379	11,379	11,379	11,379
Adjusted R^2	0.913	0.883	0.906	0.893	0.901

Table 11: Executive Overconfidence, Gender, and Firm Innovation – Innovative Industries

This table reports results of OLS regressions using the overconfidence and gender characteristics of the C-suite to predict 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. 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. P-values are calculated using robust standard errors and are shown in parenthesis.

	Log(1+Patents)	Log(1+ TTcitation)	Log(1+ Qcitation)	Log(1+Patent Value - Nominal)
P(Overconfident-Male)-top 5	-0.060*	-0.054	-0.060	-0.113
	(0.066)	(0.135)	(0.123)	(0.116)
P(Overconfident-Female)-top 5	0.005	0.080	0.052	-0.025
	(0.947)	(0.339)	(0.555)	(0.874)
P(Non-Overconfident-Female)-top 5	0.114*	0.071	0.142*	0.180
	(0.087)	(0.363)	(0.088)	(0.279)
P(Overconfident-Male)-top 5 * I(Innovative Industry)	0.143***	0.117***	0.161***	0.384***
	(0.000)	(0.008)	(0.001)	(0.000)
P(Overconfident-Female)-top 5 * I(Innovative Industry)	0.406***	0.360***	0.403***	0.890***
	(0.000)	(0.007)	(0.004)	(0.000)
P(Non-Overconfident-Female)-top 5 * I(Innovative Industry)	-0.117	-0.235*	-0.210	-0.225
	(0.289)	(0.061)	(0.111)	(0.303)
I(Innovative Industry)	0.084***	0.145***	0.155***	0.192***
	(0.007)	(0.000)	(0.000)	(0.004)
Log(Sales)	0.303***	0.269***	0.305***	0.558***
	(0.000)	(0.000)	(0.000)	(0.000)
Log(PPE/EMP)	0.048**	0.078***	0.057**	0.040
	(0.015)	(0.001)	(0.017)	(0.190)
Stock Return	-0.001	0.010	0.002	0.034*
	(0.962)	(0.533)	(0.886)	(0.086)
Log(1+Tenure-CEO)	-0.006	-0.038***	-0.021*	-0.013
	(0.543)	(0.001)	(0.074)	(0.459)
Log(1+Delta-top 5)	0.012	0.023*	0.024*	0.093***
	(0.323)	(0.090)	(0.077)	(0.000)
Log(1+Vega-top 5)	0.006	-0.003	0.000	-0.015
	(0.520)	(0.780)	(0.981)	(0.315)
Institutional Ownership	-0.041	-0.042	-0.055	-0.125**
	(0.256)	(0.328)	(0.203)	(0.034)
P(Female)-Board	0.383***	0.357***	0.479***	0.678***
	(0.001)	(0.006)	(0.000)	(0.000)
P(Independent)-Board	-0.087	-0.042	-0.073	-0.147
	(0.127)	(0.580)	(0.303)	(0.144)
Log(Board Size)	-0.029	-0.052	-0.069	-0.177**
	(0.587)	(0.412)	(0.276)	(0.040)
Year Fixed Effects	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes
Observations	11,379	11,379	11,379	11,379
Adjusted R^2	0.913	0.884	0.906	0.903

Table 12: Patent Quality

This table reports results of OLS regressions using the overconfidence and gender characteristics of the C-suite to predict 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. 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. P-values are calculated using robust standard errors and are shown in parenthesis.

	Log(1+TTcitation per Patent)	Log(1+Qcitation per Patent)	Log(1+ Patent Value – Real per Patent)
P(Overconfident-Male)-top 5	0.019	0.028**	0.131***
	(0.164)	(0.047)	(0.000)
P(Overconfident-Female)-top 5	0.048	0.125*	0.294***
	(0.209)	(0.064)	(0.003)
P(Non-Overconfident-Female)-top 5	-0.058*	-0.010	0.036
	(0.079)	(0.778)	(0.651)
Log(Sales)	0.019*	0.033***	0.250***
	(0.069)	(0.001)	(0.000)
Log(PPE/EMP)	0.004	-0.002	-0.017
	(0.698)	(0.826)	(0.379)
Stock Return	0.007	0.003	0.029**
	(0.376)	(0.642)	(0.019)
Log(1+Tenure-CEO)	-0.017***	-0.010*	-0.001
	(0.000)	(0.063)	(0.944)
Log(1+Delta-top 5)	0.007	0.009	0.072***
	(0.232)	(0.144)	(0.000)
Log(1+Vega-top 5)	-0.011**	-0.010**	-0.024**
	(0.013)	(0.020)	(0.024)
Institutional Ownership	-0.021	-0.033	-0.092**
	(0.287)	(0.112)	(0.021)
P(Female)-Board	0.091*	0.117**	0.231*
	(0.069)	(0.028)	(0.065)
P(Independent)-Board	0.024	0.012	-0.055
	(0.453)	(0.699)	(0.429)
Log(Board Size)	-0.026	-0.044	-0.127**
	(0.306)	(0.109)	(0.031)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	11,379	11,379	11,379
Adjusted R^2	0.644	0.757	0.796

Table 13: Patent Quality – Innovative Industries

This table reports results of OLS regressions using the overconfidence and gender characteristics of the C-suite to predict 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. 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. P-values are calculated using robust standard errors and are shown in parenthesis.

	Log(1+TTcitation per Patent)	Log(1+Qcitation per Patent)	Log(1+ Patent Value – Real per Patent)
P(Overconfident-Male)-top 5	-0.000	-0.006	-0.049
	(0.988)	(0.755)	(0.377)
P(Overconfident-Female)-top 5	0.036	0.036	-0.021
	(0.350)	(0.418)	(0.859)
P(Non-Overconfident-Female)-top 5	0.008	0.045	0.072
	(0.825)	(0.305)	(0.586)
P(Overconfident-Male)-top 5 * I(Innovative Industry)	0.027	0.046**	0.242***
	(0.165)	(0.036)	(0.000)
P(Overconfident-Female)-top 5 * I(Innovative Industry)	0.026	0.051	0.477***
	(0.658)	(0.432)	(0.004)
P(Non-Overconfident-Female)-top 5 * I(Innovative Industry)	-0.105**	-0.092	-0.089
	(0.048)	(0.119)	(0.578)
I(Innovative Industry)	0.096***	0.117***	0.158***
	(0.000)	(0.000)	(0.002)
Log(Sales)	0.020**	0.036***	0.257***
	(0.048)	(0.001)	(0.000)
Log(PPE/EMP)	0.006	0.000	-0.012
	(0.553)	(0.967)	(0.526)
Stock Return	0.008	0.005	0.032***
	(0.284)	(0.468)	(0.008)
Log(1+Tenure-CEO)	-0.017***	-0.010**	-0.002
	(0.000)	(0.048)	(0.895)
Log(1+Delta-top 5)	0.007	0.009	0.072***
	(0.206)	(0.124)	(0.000)
Log(1+Vega-top 5)	-0.011**	-0.009**	-0.023**
	(0.017)	(0.028)	(0.031)
Institutional Ownership	-0.024	-0.036*	-0.099**
	(0.231)	(0.078)	(0.013)
P(Female)-Board	0.097*	0.125**	0.266**
	(0.053)	(0.018)	(0.032)
P(Independent)-Board	0.022	0.010	-0.058
	(0.490)	(0.757)	(0.397)
Log(Board Size)	-0.029	-0.047*	-0.131**
	(0.259)	(0.086)	(0.024)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	11,379	11,379	11,379
Adjusted R^2	0.647	0.760	0.799

Table 14: Predicting M&A Events – Instrumental Variable Analysis

This table reports both stages of an instrumental variables approach. I use an OLS regression in the first stage and a logit regression in the second stage. In the first stage, the dependent variable is the endogenous variable P(Non-Overconfident-Female)-top 5. In the second stage, the dependent variable is I(MA-Deal). 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. 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. Coefficients are average marginal effects. P-values are shown in parenthesis and are calculated using bootstrapped standard errors.

	First Stage	Second Stage
Instrumented P(Non-Overconfident-Female)-top 5		-0.645**
		(0.021)
P(Non-Overconfident-Female-Connection)-Board	0.017**	
	(0.047)	
Size	-0.005***	0.110**
	(0.000)	(0.042)
Q	-0.005***	-0.022
	(0.000)	(0.247)
Cash Flow	0.005	0.362
	(0.725)	(0.120)
Debt	-0.005	0.173
	(0.474)	(0.137)
R&D	-0.001	-0.158
	(0.763)	(0.253)
Total Stock Ownership-top 5	-0.056	-1.610***
	(0.126)	(0.007)
Total Vested Options-top 5	0.249***	-0.132
	(0.006)	(0.942)
Age-top 5	-0.001***	-0.017***
	(0.001)	(0.000)
Board Size	0.016**	-0.105
	(0.014)	(0.454)
P(Female)-Board	0.118***	0.681*
	(0.000)	(0.093)
P(Independent)-Board	0.034***	0.432***
	(0.003)	(0.005)
Tenure-CEO	0.000	-0.003
	(0.395)	(0.272)
Year*Industry Fixed Effects	Yes	Yes
Observations	8,598	8,598

Table 15: Instrumental Variables Analysis

This table provides summary statistics for variables used to predict the firm innovation using instrumental variables analysis. P(Non-Overconfident-Female-Connection)-Board is the proportion of the board that has had a bad experience with an overconfident female executive. N(Female)-Higher Education is the total number of females (in millions) that have at least a masters degree in the state in which the firm is incorporated. 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. 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. P-values are calculated using robust standard errors and are shown in parenthesis.

	First Stage	Second Stage			
	P(Overconfident-Female)-top 5	Log(1+Patents)	Log(1+ TTcitation)	Log(1+ Qcitation)	Log(1+Patent Value - Real)
Instrumented P(Non-Overconfident-Female)-top 5		29.599***	29.855***	33.306***	41.135***
		(0.000)	(0.000)	(0.000)	(0.000)
P(Overconfident-Female-Connection)-Board	-0.161**				
	(0.050)				
Log(Sales)	-0.027***	0.485***	0.485***	0.504***	0.789***
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Log(PPE/EMP)	0.003	0.041***	0.035**	0.036**	0.114***
	(0.699)	(0.006)	(0.025)	(0.035)	(0.000)
Stock Return	0.006	0.070*	0.100**	0.089*	0.150**
	(0.793)	(0.078)	(0.017)	(0.053)	(0.012)
Log(1+Tenure-CEO)	-0.001	-0.008***	-0.008***	-0.009***	-0.017***
	(0.645)	(0.002)	(0.001)	(0.002)	(0.000)
Log(1+Delta-top 5)	0.067***	-0.196***	-0.175***	-0.196***	-0.101**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.049)
Log(1+Vega-top 5)	-0.045***	0.428***	0.415***	0.500***	0.621***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Institutional Ownership	0.241***	-1.730***	-1.750***	-1.912***	-2.399***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P(Female)-Board	1.157***	-6.372***	-6.713***	-7.271***	-8.556***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P(Independent)-Board	-0.128*	1.689***	1.545***	1.916***	2.777***
	(0.056)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Board Size)	-0.055	0.251***	0.274***	0.270**	0.453***
	(0.268)	(0.010)	(0.008)	(0.017)	(0.002)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	8,510	8,510	8,510	8,510	8,510
Adjusted R^2	NA	0.368	0.321	0.356	0.414

Appendix C: Robustness Checks

Table 16: Predicting M&As – Total Number of Acquisitions

This table reports OLS regressions where the dependent variable is the total number of M&As 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. 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. Coefficients are average marginal effects. P-values are shown in parenthesis.

	(1)	(2)	(3)
P(Female)-top 5	-0.303***		
	(0.001)		
P(Overconfident-Female)-top 5		-0.153	-0.097
		(0.225)	(0.441)
P(Non-Overconfident-Female)-top 5		-0.420***	-0.294**
		(0.000)	(0.011)
P(Overconfident-Male)-top 5			0.192***
			(0.000)
Size	0.130***	0.128***	0.127***
	(0.000)	(0.000)	(0.000)
Q	0.028***	0.027***	0.017*
	(0.002)	(0.003)	(0.055)
Cash Flow	-0.002	-0.006	-0.063
	(0.988)	(0.968)	(0.646)
Debt	-0.033	-0.031	-0.011
	(0.701)	(0.720)	(0.897)
R&D	0.049	0.048	0.038
	(0.223)	(0.233)	(0.340)
Total Stock Ownership-top 5	-0.495	-0.511	-0.499
	(0.302)	(0.287)	(0.297)
Total Vested Options-top 5	-0.474	-0.471	-0.415
	(0.644)	(0.646)	(0.685)
Age-top 5	-0.008***	-0.008***	-0.010***
	(0.007)	(0.007)	(0.001)
Board Size	-0.019	-0.016	-0.019
	(0.795)	(0.820)	(0.789)
P(Female)-Board	-0.319**	-0.332**	-0.317**
	(0.045)	(0.038)	(0.047)
P(Independent)-Board	-0.033	-0.028	-0.011
	(0.730)	(0.771)	(0.907)
Tenure-CEO	-0.001	-0.001	-0.003
	(0.474)	(0.464)	(0.176)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	8,141	8,141	8,141

Table 17: Predicting M&As – Total Dollar Value of Acquisitions

This table reports OLS regressions where the dependent variable is the log of 1 plus the total dollar value of M&As 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. 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. Coefficients are average marginal effects. P-values are shown in parenthesis.

	(1)	(2)	(3)
P(Female)-top 5	-0.708**		
	(0.020)		
P(Overconfident-Female)-top 5		-0.115	0.026
		(0.789)	(0.952)
P(Non-Overconfident-Female)-top 5		-1.172***	-0.852**
		(0.002)	(0.031)
P(Overconfident-Male)-top 5			0.487***
			(0.000)
Size	0.542***	0.534***	0.531***
	(0.000)	(0.000)	(0.000)
Q	0.062**	0.057*	0.033
	(0.039)	(0.060)	(0.282)
Cash Flow	0.307	0.293	0.148
	(0.510)	(0.529)	(0.751)
Debt	0.623**	0.631**	0.681**
	(0.035)	(0.033)	(0.021)
R&D	0.062	0.058	0.034
	(0.652)	(0.673)	(0.807)
Total Stock Ownership-top 5	-1.004	-1.068	-1.036
	(0.540)	(0.514)	(0.527)
Total Vested Options-top 5	-0.581	-0.570	-0.429
	(0.868)	(0.871)	(0.902)
Age-top 5	-0.024**	-0.025**	-0.028***
	(0.016)	(0.015)	(0.005)
Board Size	-0.266	-0.256	-0.264
	(0.276)	(0.293)	(0.279)
P(Female)-Board	-0.535	-0.583	-0.545
	(0.326)	(0.284)	(0.316)
P(Independent)-Board	0.090	0.110	0.153
	(0.786)	(0.739)	(0.643)
Tenure-CEO	-0.009	-0.009	-0.012*
	(0.176)	(0.171)	(0.068)
Year Fixed Effects	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes
Observations	8,141	8,141	8,141