Open Journal of Business and Management, 2024, 12, 3973-4007
https://www.scirp.org/journal/ojbm
ISSN Online: 2329-3292
ISSN Print: 2329-3284

# With Great Power Comes Great Flexibility: The Impact of Prestigious CEO Awards on Innovation

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**How to cite this paper:** Park, K. J., & Atanassov, J. (2024). With Great Power Comes Great Flexibility: The Impact of Prestigious CEO Awards on Innovation. *Open Journal of Business and Management, 12,* 3973-4007.
https://doi.org/10.4236/ojbm.2024.126199

**Received:** September 28, 2024
**Accepted:** November 1, 2024
**Published:** November 4, 2024



## Abstract

Contrary to the previous literature, we document that winning a prestigious CEO award can be beneficial to firms by reducing managerial career concerns and encouraging long-term productivity. Using propensity score matching techniques, we find that award-winning CEOs innovate more than the control group, both in terms of the number of patents and the number of citations per patent. This finding is consistent with both managerial flexibility and overconfidence theories, and inconsistent with the private benefits view. After further analysis, we show that there is a clear increase in CEO power and job security after winning a prestigious award and no such increase in several measures of overconfidence. We also document that the positive effect of CEO awards on innovation is weaker for firms with high institutional ownership. These results provide overall support for the managerial flexibility theory.

## Keywords

Superstar CEO, Business Awards, Prestigious Awards, Innovation, Managerial Entrenchment, Corporate Governance, Agency Theory, Managerial Myopia, Overconfidence, Institutional Ownership

## 1. Introduction

In this paper we revisit an old question about the effect of managerial job security on firm performance. Malmendier and Tate (2009) document that prestigious awards turn CEOs into superstars and increase their job security and entrenchment. Consequently, CEOs increase the extraction of rents from shareholders using their heightened status and power and are often distracted from their core operational responsibilities, which leads to operating underperformance relative to their peers. This paper builds upon the Malmendier and Tate (2009) by examining if becoming a superstar universally diminishes CEOs' performance and if there are certain types of investment policies that could benefit the firm from the increased CEO job security.

We argue that while receiving a prestigious award may increase entrenchment, it also increases managerial flexibility and tolerance to experimentation, which is one of the most important factors that drive innovation (Manso, 2011). We demonstrate that there is a bright side to increased job security after such awards. Specifically, rather than focusing on short-term accounting and stock performance, we examine whether firms run by superstar CEOs become more innovative than their peers. We focus on innovation, because is considered one of the most important determinants of long-term firm growth and value creation (Kogan et al., 2017; Hall et al., 2005; Atanassov, 2013). We overcome several empirical challenges by using a propensity score matching and hand-collecting data on prestigious awards conferred by major national magazines in the U.S. to identify a plausible exogenous shock to CEOs' behavior.

This paper contributes to the extant literature in several ways. First, the recent innovation literature has explored how managerial entrenchment (CEO power) affects corporate innovation. One segment of these studies finds support for the agency view (e.g., Atanassov, 2013), while the other for the managerial flexibility view (Becker-Blease, 2011; Acharya, Baghai, and Subramanian, 2012; Chemmanur and Tian, 2018)[1]. This paper offers new evidence that shed light on which of these two perspectives—agency theory or managerial flexibility theory—better explains a firm's innovation outcomes. Furthermore, the previous literature shows that powerful CEOs, on average, expropriate shareholders and make value-decreasing decisions such as implementing inefficient pet projects (Jensen, 1988), overpaying the target firm in the takeover market (Masulis, Wang, and Xie, 2007), engaging in a quiet-life (Bertrand and Mullainathan, 2003), designing their own suboptimal compensation schemes (Yermack, 1997; Bebchuk and Fried, 2003), or underperforming in a short-run (Malmendier and Tate, 2009). However, most of the existing literature frequently uses protection from hostile takeovers as a proxy for managerial entrenchment, despite the fact that hostile takeovers have largely disappeared over the past two decades. Using a prestigious award, rather than the threat from hostile takeovers helps researchers identify a different and more recent shock that in turn illustrates the extent to which managers achieve job security.

In employing innovation as a measure of performance, this study complements the previous literature by providing evidence for a positive aspect of CEO entrenchment: greater power and job security as a result of winning a high-profile

[1]Sapra, Subramanian, and Subramania (2014) show that the agency view and the managerial myopia view are only "locally" correct. They argue that a relation between governance mechanisms and innovation is non-monotonic due to the tradeoff decision between expected takeover premiums and expected managerial private benefits of control.

CEO award increases managerial flexibility, resulting in more innovation[2]. Additionally, the evidence in this paper helps resolve the current puzzling issue of why many firms have actively chosen to weaken shareholders' power while giving power to their CEOs despite the findings in previous literature that managerial power (entrenchment) leads to negative consequences for the firm[3].

The structure of the rest of this paper is as follows. In Section 2, we review previous literature related to managerial entrenchment, managerial overconfidence, and corporate innovation, and develop empirical predictions on the effects of winning a prestigious award on innovation. Section 3 describes the data and variable constructions and Section 4 reports the empirical results and robustness tests. We also present evidence of how winning a prestigious award shifts power towards CEOs and how it affects CEO overconfidence in Section 5. In Section 6, we investigate heterogeneous award-winning effects across firms by institutional ownership. Conclusions are presented in Section 7.

## 2. Literature Review

Achieving superstar CEO status by receiving a high-profile CEO award can affect CEOs' long-term incentives via greater power and job security. Hermalin and Weisbach (1998) argue that the effectiveness of disciplining a CEO depends on her perceived ability relative to a replacement. Winning a prestigious award improves the reputation of the CEO and increases her power vis-à-vis the board, resulting in less effective monitoring but also in increased flexibility. In addition, if a CEO wins a prestigious award, the perception by the shareholders of the CEO's quality (justified or not) improves. If the board fires such a superstar CEO, it may suffer a backlash from shareholders (Fisman, Khurana, and Rhodes-Kropf, 2013) or from the public, more generally.

Given the argument that award-winning CEOs achieve greater power and job security, three strands of research make different predictions about the effect of winning a prestigious award on innovation. The agency theory presented by Jensen (1986, 1988) argues that more entrenched managers waste corporate resources

[2]This study differs in several ways from Malmendier and Tate's (2009) paper, which was the first to address the effects of winning a prestigious award. First, they investigate how superstar CEOs perform in the three years following the award while we focus on the effects of winning an award on longer term measures of performance, namely innovation outputs. The evidence in this paper, therefore, can be reconciled with Malmendier and Tate's finding of underperformance by superstar CEOs in that, after winning an award, they achieve greater leeway to maximize the long-term value of the company at the cost of short-term profits. Secondly, Malmendier and Tate see winning a prestigious award as a shock that shifts CEO power temporarily, whereas we consider both possibilities; the power shift as a result of winning a high-profile award can be either permanent or temporary. Lastly, in our robustness check, we use a sample period that extends back to 1976 and test whether the effects of winning an award is time-specific, expanding Malmendier and Tate's sample period by 16 years.

[3]Facebook, Google, and LinkedIn went public with dual class shares to allow their CEOs to maintain their decision-making power. For example, as of 2014, Mark Zuckerberg controls Facebook personally despite the fact that he owns only about 20 percent of the company due to supervoting "class B" shares. Google issued "class B" and "class C" shares to give a majority of votes to Larry Page and Sergey Brin. In this way, those CEOs can retain their control over their firms without allowing any potential conflicts with other shareholders over the firms' directions.

in pursuing value-destroying pet projects or simply enjoy the quiet life by undertaking routine projects or no projects at all (Bertrand and Mullainathan, 2003). Managers will spend less time, effort, and resources on technologically innovative projects that maximize shareholder wealth and help the firm thrive in the long-run. They will also be slow in responding to technological changes, and as a result the firm will lag behind its competitors. Therefore, the agency hypothesis predicts that winning an award will lead to less innovation.

On the other hand, Manso (2011) argues that one of the most important determinants of innovation is the tolerance to experimentation and failure. When managers have greater job security and enjoy greater perceived reputation because of winning a prestigious award, they will have more power and flexibility to experiment with novel ideas because they will be less afraid that they lose their jobs if they fail. Using a different argument, Stein (1988, 1989) suggests that, due to asymmetric information, the stock market may undervalue the stocks of firms that invest in long-term innovative projects. Consequently, to protect current shareholders and themselves from dismissal due to perceived poor performance, managers are more likely to focus on boosting current earnings at the expense of novel projects. Under this managerial myopia view, managers tend to invest in long-term and innovative projects if they have more power and face a lower threat of job dismissal. Therefore, based on the managerial flexibility hypothesis, receiving a high-profile award can spur innovation.

It is important to note that winning a high-profile award may not only affect CEO power but may change the CEO's psychological traits after the award. Receiving a high-profile award, conferred by reliable outside authorities such as *Business Week*, *Forbes*, etc., can overstate CEOs' beliefs in their own abilities and future outcomes, causing them to become overconfident. Hirshleifer, Low, and Teoh (2012) find that overconfident managers achieve greater success in innovative activities. Based on the overconfidence hypothesis, therefore, we expect that award-winning CEOs innovate more.

## 3. Methodology, Data, and Variable Construction

### 3.1. Data

We hand-collect a list of the winners of CEO awards conferred by prominent national magazines between 1976 and 2011. Following Malmendier and Tate (2009), we select CEO awards that meet the following conditions: 1) the magazines that grant the awards are popular and circulated nationally; 2) all CEOs are eligible for an award. As a result, only awards that are conferred by the following magazines are included in our sample: *Business Week*, *Financial World*, *Chief Executive*, *Electronic Business Magazine*, *Ernst & Young*, *Forbes*, *Industry Week*, *Marketwatch.com*, *Morningstar.com*, *Time*, *and Time/CNN*. Among the listed magazines, *Business Week* and *Financial World* provide the majority of the award-winners in this sample. The main characteristics of each award are as follows:

*Business Week* has been awarding Best Manager and Best Entrepreneur annually since 1988. From 1992 to 1995, about 15 Best Managers were selected each year, increasing to 25 per year from 1996 onward. The Best Entrepreneur award was given more sporadically, with no awards in 1992 or 2000, and between 3 to 10 recipients in other years.

*Financial World* published its annual "CEOs of the Year" list for over 20 years until 1997. Winners were classified into Gold (1 winner), Silver (about 10 winners per year until 1994, then 1 per industry in 1995-1996, and 5 in 1997), Bronze (1 per industry), and Certificates of Distinction (2 per industry). With around 60 industries represented annually, we focus on the Gold and Silver winners only to study "superstars".

*Chief Executive* has named a CEO of the Year annually since 1987, with the winner selected by a panel of CEOs.

*Electronic Business Magazine* has named a CEO of the Year annually since 1997, selected by the editorial staff.

*Ernst & Young* has been awarded the "Entrepreneur of the Year" annually since 1989, chosen by independent judges.

*Forbes* began listing "Best Performing CEOs" in 2001, chosen by the editorial staff.

*Industry Week* initially awarded CEOs in four categories in 1986-1987, later consolidating to two categories in 1989 and 1991. Since 1993, the magazine has named one overall CEO of the Year, except in 1994 (three winners) and 1995 (five winners).

*Morningstar.com* began naming a CEO of the Year in 1999, with two winners in 1999 and 2001, and one winner in other years.

*Time* has named a "Person of the Year" for over 50 years. A CEO received the honor three times since 1975 (in 1991, 1997, and 1999).

*Time and CNN* created a list of the 25 Most Influential Global Executives In 2001.

The CEO award data is then matched with CEO and firm characteristics variables. We obtain CEO demographic and compensation information from the Execucomp database. We attain CEO incentive measures (delta and vega) from Lalitha Naveen's website[4]. We collect CEO turnover data from Kuhnen's website. As the Execucomp database only provides executive data from 1992, our sample includes only CEO award winners since 1992. All firm information and characteristics are extracted from Compustat. We exclude non-US firms from the sample because non-US firms are different from US firms across many dimensions such as ownership structure, governance scheme, legal protections to shareholders, business laws, and corporate culture. In addition, CEOs of non-US firms might not have the same chance of winning awards as those of US firms. We obtain stock return data for the sample firms from the Center for Research in Security Prices (CRSP). We calculate risk-adjusted returns by using Carhart's four factor model.

[4]https://sites.temple.edu/lnaveen/data/.

The Fama-French return factors ($R_m$-$R_f$, SMB, and HML) and momentum factors (UMD) for each year are collected from Ken French's online website[5]. Finally, we merge the sample with the patent data. The patent data is obtained from the National Bureau of Economic Research (NBER) patent database (Hall, Jaffe, and Trajtenberg, 2001). It provides the number of patents and citations for each firm at year $t$ and the mean number of patents and citations at year $t$ across firms and industries. As the patent data is only available up to 2006 and we focus on changes in innovation activity in the four years following a prestigious CEO award, our final sample period is restricted to the years between 1992 and 2002. After we match the CEO award data with Execucomp, Compustat, CRSP, and patent data, a total of 263 awards (163 unique award-winners) are identified.

## 3.2. Variable Construction for Propensity Score Matching[6]

### 3.2.1. Treatment Variable: Award Dummy

Winning a prestigious award attracts public attention and award-winning CEOs are likely to appear in the media more frequently, thereby becoming a public face of their corporation and a nationwide "superstar". The CEOs, then, are likely to use this increased status to maintain their superstar standing throughout their tenure. In other words, winning a high-profile award is likely to shift an award-winner's status in the firm permanently (until he/she leaves or retires from the company), regardless of whether he/she receives later awards or not. Therefore, as a treatment dummy, we use an award indicator variable equal to one for all the years after the award and zero before the award for all award-winners. An indicator variable equal to zero is used for all years for all non-winners.

### 3.2.2. Outcome Variables

The outcome variable of interest in the propensity score matching is a firm's innovation outputs. Innovation is considered the key to the long-term success of a firm. In addition, measures of the firm's performance in previous literature might not correctly reflect a firm's intrinsic value. For example, Stein (1988) argues that, due to information asymmetry, investors tend to undervalue stocks of firms that invest in long-term innovative projects. Cohen, Diether, and Malloy (2013) establish that the stock market tends to misvalue the impounded information about innovation and, as a result, current stock prices do not correctly reflect the intrinsic value of stocks. Hirshleifer, Hsu, and Li (2013) assert that information regarding innovation is hard for investors to process due to its intangibility and high uncertainty and therefore the stock market may misprice the fundamental value of the firms. Their finding suggests that innovation efficiency (measured by patents or citations per dollar of research and development) provides information to predict a firm's future return. Therefore, innovation better reflects a firm's fundamental value than the conventional measures of a firm's performance such as stock return performance.

[5]http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[6]More details about the propensity score matching method are described in **Appendix B**.

As a quantity measure of innovation, we use the number of patents for each firm at year *t*. The NBER patent database includes patents only if they are successfully granted. In addition, on average, it takes two years for applied patents to be granted. Thus, the most recent applied patents (in 2004 and 2005) may not be included in the database. To control for this truncation bias, we divide the number of patents for each firm-year by the mean number of patents for the same year (Hall et al., 2001).

However, the number of patents does not necessarily represent the technological and economic importance of these patents. Patents that are more frequently cited tend to be more valuable economically and technologically. Therefore, we also use the number of citations per patent as a measure of the quality of innovation. Nonetheless, the number of citations per patent may also suffer from a truncation bias. Patents granted in more recent years have fewer chances of being cited than those that were granted in earlier years. To control for this truncation bias, we scale the citation measure by the average number of citations per patent of all patents in the same year (Hall et al., 2001). We winsorize the two innovation output variables at the 95$^{th}$ percentile[7].

### 3.2.3. Matching Variables

A propensity score matching selects predicted winners based on the propensity scores estimated in the logistic regression. As a dependent variable, we use an award dummy variable equal to one if CEOs win their awards at year *t* and equal to zero otherwise. A criteria of selection for matching variables is that they might affect either the likelihood of winning an award, the innovation outcome, or both. The intuition behind the criteria of matching variables is that treatment groups and matched groups must be similar in terms of the propensity to win an award and of future innovation incentives. Following Malmendier and Tate (2009), we use 1-year Carhart's four-factor risk-adjusted stock returns prior to the award, CEO age, and CEO tenure as matching variables to estimate propensity scores in order to predict award-winners. Matching variables to estimate propensity scores for innovation incentives reported in the innovation literature are sales, R&D, cash, leverage, profitability, tangibility, firm age, and CEO incentives (delta and vega)[8]. All matching variables are measured at the end of the last fiscal year prior to the award grant month.

Most of the CEO awards in the sample are conferred either at the end of the year or at the beginning of the next year. Thus, we set time *t* as the month of the award, year *t* − 1 denotes the calendar year prior to the award, and year *t* + 1 denotes the calendar year after the award. For example, *Business Week* awarded Steve Jobs one of the "Best Managers of 1998" in January 11, 1999. Therefore, year

[7]Previous literature uses a firm's R&D expenditure to measure that firm's innovation. However, recent innovation studies (e.g., Hirshleifer et al., 2012; Atanassov, 2013, among others) differentiate an input of innovation from an output of innovation since R&D expenditure may not be used efficiently within firms. In addition, reported R&D expenditure may be at the discretion of the reporting firms and may furthermore be subject to accounting rules.

[8]More details about variables are described in **Appendix A**.

$t-1$ denotes year 1998 and year $t+1$ represents year 1999.

To eliminate any large influence of outliers on the results, we winsorize all continuous variables at the 1st and 99th percentiles. To control for any unobservable time-invariant characteristics of each industry and any macroeconomic shock, we include industry dummies (at the two-digit SIC level) and year dummies in the first stage regression. The standard errors are clustered at the CEO/firm level. Therefore, the specification of the logit regression is as follows.

$$\begin{aligned}\text{Award Dummy}_t &= \alpha_t + \beta_t \text{set of Matching variables}_{t-1} \\ &\quad + \gamma \text{Industry effects} + \delta \text{Year effects} + \varepsilon_t\end{aligned}$$

## 4. Empirical Results: Prestigious Business Awards and Innovation

### 4.1. Summary Statistics

If treatment groups are randomly assigned, treatment and control groups are, on average, similar across all firm/CEO characteristics. If this is the case, one can estimate the average treatment effect for treated groups simply by comparing the outcomes between treatment groups and control groups. However, Table 1 shows that this is not the case. Both treatment groups (first-time award-winners and all award-winners) are heterogeneous with non-winners (the non-treatment group) across many dimensions of firm and CEO characteristics. Based on sales, total assets, and market capitalization, award-winners manage significantly larger firms than non-winners' firms. With respect to past stock market performance (1yr-, 2yr-, and 3yr-stock returns prior to an award) and accounting performance, as expected, award-winners' firms are better performers than non-winners' firms. Award-winners' firms have a higher Tobin's Q and their firms belong to more competitive industries than non-winners. Award-winners are compensated more than non-winners and they have a higher pay for performance (delta) and higher risk-taking incentives (vega). These heterogeneous characteristics between the treatment group and the non-treatment group make it difficult to estimate the average treatment effect by directly comparing the outcomes between treated and non-treated groups.

### 4.2. First Stage Regression Result

Table 2 shows the results of the first-stage propensity score matching procedure (using a logit regression) to estimate propensity scores, based on the sample of 3092 groups (CEO-firm) and 12,435 CEO-firm-year observations. The dependent variable is a dummy variable equal to one if the CEO wins an award at year *t*, while explanatory variables are those used as matching variables in the framework of the propensity score matching procedure. The coefficients are presented as odds ratios and standard errors are clustered by a firm/CEO match to control for potential cross-sectional dependence in residuals. We use industry dummies at the two-digit SIC level to control for unobservable heterogeneity across industries,

**Table 1.** Summary statistics.

| Variables | First-time award winners (N = 163) | | | | | Non-winners (N = 23,441) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Median | Std. Dev. | Min | Max | Mean | Median | Std. Dev. | Min | Max |
| *Matching variables* | | | | | | | | | | |
| Sales ($ in thousands) | 14,780 | 5454 | 30,353 | 47.35 | 218,529 | 3880 | 963 | 11,854 | 0 | 375,376 |
| Past 1-year return (%) | 57.62 | 23.49 | 217.92 | −40.00 | 2619 | 21.11 | 11.93 | 66.69 | −97.84 | 1494.34 |
| R&D expense/assets | 0.032 | 0.004 | 0.048 | 0.000 | 0.220 | 0.031 | 0 | 0.073 | 0 | 2.09 |
| Leverage | 0.23 | 0.19 | 0.17 | 0 | 0.88 | 0.23 | 0.21 | 0.2 | 0 | 4.91 |
| Profitability | 0.15 | 0.15 | 0.10 | −0.42 | 0.43 | 0.13 | 0.13 | 0.13 | −2.67 | 1.71 |
| Tangibility | 0.31 | 0.27 | 0.23 | 0 | 0.9 | 0.29 | 0.22 | 0.24 | 0 | 0.97 |
| Cash/assets | 0.08 | 0.05 | 0.08 | 0 | 0.38 | 0.09 | 0.04 | 0.11 | −0.01 | 0.96 |
| Firm age (years) | 28.73 | 23 | 22.72 | 1 | 77 | 21.35 | 16 | 18.31 | 1 | 82 |
| CEO delta ($) | 3945 | 520 | 16,729 | 0 | 174,744 | 1111 | 196 | 11,625 | 0 | 709,828 |
| CEO vega ($) | 196.54 | 77.84 | 332.45 | 0 | 2237 | 113.05 | 37.89 | 269.1 | 0 | 11,344 |
| CEO age (years) | 54.34 | 55 | 7.14 | 45 | 86 | 55.17 | 55 | 7.58 | 36 | 98 |
| CEO tenure (years) | 5.89 | 4 | 5.97 | 0 | 30 | 7.13 | 5 | 7.34 | 0 | 55 |
| *Other firm and CEO characteristics* | | | | | | | | | | |
| Market cap. ($ in thousands) | 26,525 | 10,471 | 54,278 | 105 | 398,000 | 5397 | 1127 | 18,529 | 1937 | 602,000 |
| Total assets | 27,089 | 5712 | 66,094 | 46.89 | 495,023 | 10,010 | 1195 | 52,291 | 3.43 | 1884.318 |
| Past 2-year return (%) | 141.05 | 57.31 | 420.08 | −53.33 | 4081 | 50.15 | 25.96 | 157.33 | −99.13 | 7749 |
| Past 3-year return (%) | 204.65 | 80.82 | 538.38 | −77.60 | 4975 | 81.57 | 39.76 | 235.17 | −99.81 | 13,767 |
| Book-to-market ratio | 0.33 | 0.31 | 0.22 | −0.06 | 1.06 | 0.5 | 0.44 | 0.76 | −34.02 | 33.11 |
| Tobin's Q | 3.74 | 1.95 | 8.83 | 0.98 | 105.09 | 2.08 | 1.51 | 2.25 | 0.29 | 100.81 |
| G index | 9.35 | 9 | 2.78 | 3 | 16 | 9.26 | 9 | 2.69 | 1 | 19 |
| CEO total compensation ($) | 8492 | 3877 | 13,897 | 82.8 | 134,437 | 4148 | 1957 | 9955 | 0 | 655,448 |
| CEO cash compensation ($) | 2017 | 1530 | 1957 | 0 | 17,966 | 1228 | 845 | 1691 | 0 | 102,449 |

The table reports summary statistics for first-time award-winners and all non-winners in the sample. The CEO and firm variables are described in **Appendix A**. All variables are measured at *year t* − 1 where awards are granted at *t*.

**Table 2.** First stage: Logit regression.

| Variables | Coefficient |
|---|---|
| | (Robust SEs) |
| Ln(sales) | **0.885*** ** |
| | (0.089) |
| Prior 1-Year Return | **1.000*** ** |
| | (0.117) |
| R&D Expense/Assets | 0.924 |
| | (2.300) |

**Continued**

| | |
|---|---|
| Leverage | −1.329 |
| | (0.914) |
| Profitability | −0.501 |
| | (1.410) |
| Tangibility | 0.984 |
| | (0.734) |
| Cash/assets | **2.127*** |
| | (1.182) |
| Ln(1 + firm age) | −0.148 |
| | (0.094) |
| Ln(1 + CEO delta) | **0.529***** |
| | (0.082) |
| Ln(1 + CEO vega) | −0.029 |
| | (0.061) |
| Ln(1 + CEO age) | −0.083 |
| | (0.101) |
| Ln(1 + CEO tenure) | **−1.841**** |
| | (0.835) |
| Industry dummies | YES |
| Year dummies | YES |
| Pseudo $R^2$ | 0.29 |
| Observations | 12,435 |
| Groups | 3092 |

This table reports logit regression results. The dependent variable is an indicator variable of whether a CEO wins an award at year *t*. The explanatory variables are those used as matching variables for a propensity score matching (presented in Table 1). The selection criteria for the matching variables are those which affect either likelihood to win awards (participation in treatment groups) or innovation activities (outcomes). The variables used in the first stage regression are described in the Appendix. Standard errors are clustered by a CEO/firm match and are shown in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively.

$$\text{Award Dummy}_t = \alpha_t + \beta_t \text{set of Matching variables}_{t-1} + \gamma \text{Industry effects} + \delta \text{Year effects} + \varepsilon_t .$$

and include year dummies to control for any macroeconomic shocks[9]. The logit regression results are consistent with findings from the summary statistics in Table 1. CEOs who manage larger (in terms of sales), better performing (in terms of stock returns), and cash-sufficient firms are more likely to receive awards. In addition, CEOs whose compensation is more tied to performance and CEOs with a

[9]As a robustness check, we also use Fama-French 48 industries or Fama-French 12 industries dummies instead of two-digit SIC level dummies. The magnitudes and significance of the coefficients for either case are very similar.

shorter tenure are more likely to win awards. Based on the coefficient estimates, we calculate a propensity score for each group at year $t$ to find matched control groups for each treatment group.

### 4.3. Second Stage: The Effect of Winning an Award on Innovation

The goal of this study is to measure the impact of prestigious CEO awards on a firm's innovation. Since winning a high-profile CEO award might affect that firm's innovation with a time lag, we focus on a firm's innovation for up to 4 years after the CEO wins an award. To improve the quality of the matching procedure, we restrict matched groups (predicted winners) by selecting within the same year groups and the same industry groups (at the two-digit SIC level). Importantly, one might argue that award-winning firms are always more innovative than other firms regardless of whether they receive prestigious awards or not, resulting in inaccurate estimates of the award-winning effect. To mitigate the potential reverse causality problem, we partition the sample firms into two groups based on the level of (scaled) patenting activities (at the median) at year $t-1$ and match actual award winners and predicted winners within each group[10]. As a result, predicted winners are selected within the same year, industry, and similar current innovation groups as actual winners. The predicted winners are chosen by a single nearest neighbor, 10-nearest neighbors, and a kernel (Gaussian) matching algorithm.

Figure 1 illustrates the mean number of patents for actual award winners, predicted winners, and non-winners over the four-year period following the awards. Although the numbers of patents for actual winners and predicted winners are similar before the awards (at year $t-1$), the data show that the actual winners' number of patents increases more than both predicted—and non-winners' over the four years following the awards.

Table 3 presents the results of the impact of CEO awards on innovation using a propensity score matching. For the number of patents (a measure of the quantity of innovation), the matching estimates (the number of patents by actual winners minus those by predicted winners) are significant year $t+1$ to $t+4$ across all three matching procedures. In other words, actual winners consistently and significantly produce more patents than predicted winners from year $t+1$ to year $t+4$, regardless of which matching algorithms are employed to select predicted winners. On average, each year actual award-winners have 20.71% (year $t+1$) to 35.45% (year $t+2$) more patents than predicted winners during the four-year period after their awards.

We find similar results for the number of citations per patent (a measure of the quality of innovation). Regardless of which matching algorithms are used (single-, multiple nearest neighbor, kernel matching), the mean differences in the scaled number of citations per patent between the two groups are significant at the 5% level for year $t$ to year $t+4$. In terms of the magnitude of effects, based on single

[10]The level of patenting activities of a firm may vary over time. Thus, instead of matching at patenting activity level at $t-1$, we match by past 2yr/3yr/5yr average patenting activity levels respectively. The main results remain similar.

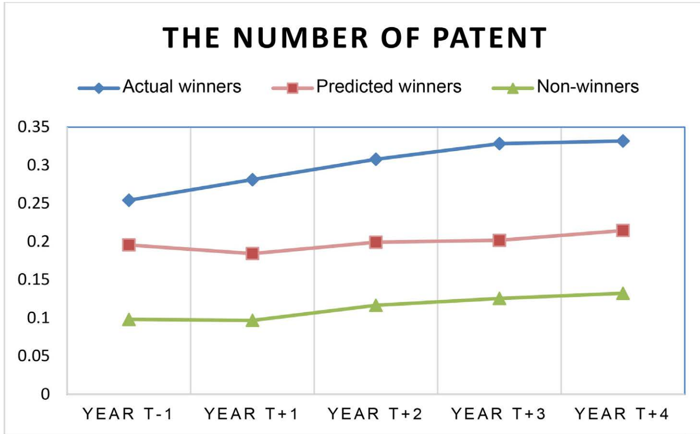



Figure 1. Mean number of patents. The graph plots the mean number of patents for first-time award-winners, predicted winners, and non-winners during the four-year period following the awards based on the sample data from 1992 to 2002. The number of patents for each firm at year *t* is divided by the mean number of patents of all firms for the same year, to account for a potential truncation bias.

Table 3. Post innovation to CEO awards.

| Outcome Variables | N (On Support) | Single Nearest Neighbor | 10-Neighbors | Kernel (Gaussian) |
|---|---|---|---|---|
| | | Matching Estimate | Matching Estimate | Matching Estimate |
| $Patent_{t+1}$ | 759 | **0.0968*****<br>(0.0172) | **0.0956*****<br>(0.0111) | **0.0992*****<br>(0.0104) |
| $Patent_{t+2}$ | 739 | **0.1087*****<br>(0.0185) | **0.1180*****<br>(0.0124) | **0.1135*****<br>(0.0117) |
| $Patent_{t+3}$ | 719 | **0.1267*****<br>(0.0206) | **0.1261*****<br>(0.0139) | **0.1242*****<br>(0.0131) |
| $Patent_{t+4}$ | 702 | **0.1173*****<br>(0.0225) | **0.1378*****<br>(0.0151) | **0.1332*****<br>(0.0144) |
| $Citation/Patent_{t+1}$ | 759 | **0.1484*****<br>(0.0447) | **0.1436*****<br>(0.0278) | **0.1330*****<br>(0.0257) |
| $Citation/Patent_{t+2}$ | 739 | **0.1688*****<br>(0.0423) | **0.1314*****<br>(0.0269) | **0.1348*****<br>(0.0248) |
| $Citation/Patent_{t+3}$ | 719 | **0.1559*****<br>(0.0421) | **0.1270*****<br>(0.0261) | **0.1297*****<br>(0.0242) |
| $Citation/Patent_{t+4}$ | 702 | **0.1531*****<br>(0.0366) | **0.1227*****<br>(0.0243) | **0.1082*****<br>(0.0227) |

This table shows a difference in innovation outputs between actual award-winners and predicted winners in the permanent shift model framework. An award indicator variable is set to one for all CEO-year observations after year *t* when a CEO wins a first award and set to zero for all non-winners. Matching variables and a matching procedure are described in the **Appendix A** and **Appendix B**. Predicted winners are selected by a single nearest neighbor, multiple nearest neighbors, and a kernel propensity score matching procedure. The outcome variables are the scaled number of patents and the scaled number of citations per patent. The matching estimates represent differences in the innovation outputs between actual winners and predicted winners. The number of observations in this table only include groups which lie within a common support region. The standard errors are estimated by bootstrapping and are reported in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively.

nearest neighbor matching estimates, the actual winners have 18.87% (year $t + 1$) to 32.23% (year $t + 4$) more citations per patent than the predicted winners for year $t$ to year $t + 4$, suggesting that the actual winners achieve more economically and technologically important innovations than predicted winners.

Since a CEO's award affects a firm's innovation with a lag, one might argue that these patenting activities are accomplished by that CEO's decisions prior to the award. However, the results show that award-winners still achieve more patents and citations per patent in later years (year $t + 3$ and $t + 4$) as well as in the first two years after the award. In sum, the results suggest that CEOs who win awards become better innovators in terms of the number of patents and the number of citations per patent after the awards than matched CEOs who do not win awards.

### 4.4. Robustness Checks

In this section, we check whether a positive award-winning effect on long-term innovation decisions is robust, regardless of whether there is a different treatment effect model assumption, broader sample periods (periods earlier than 1992), or a different estimation technique (two-stage least squares (2SLS) instrumental variable (IV) design).

#### 4.4.1. Temporary Shift Model

One might argue that winning a prestigious award affects a CEO's status temporarily. In other words, award-winning CEOs enjoy enhanced status after the award but they lose their status shortly thereafter. In this case, a different specification for an award dummy variable is required. We consider two scenarios: first-time award and multiple awards to the same CEO. We set the award indicator variable to one if a CEO wins an award at year $t$ and zero otherwise. Actual winners are matched with predicted winners within the same year, industry, and past innovation groups.

Table 4 reports the results of the temporary shift model. Panel A presents the matching estimates of a first-time award. Similar to the results of the permanent shift model in Table 3, actual winners produce more patents than benchmark CEOs from year $t$ to year $t + 4$, no matter which matching methods are used. The mean differences in the number of patents between the two groups for year $t$ to year $t + 4$ are significant at the 1% significance level. Likewise, based on nearest neighbor matching estimates, the scaled number of citations per patent is larger for the actual award-winners than for the benchmark CEOs by 19% (nearest neighbor matching estimate at year $t + 3$) to 47% (nearest neighbor estimate at year $t + 4$) and the differences between the two groups are significant at the 5% significance level except for year $t + 4$. The matching estimates by a 10-nearest neighbor matching and kernel matching confirm that actual winners have more citations per patent than predicted winners and the differences are all significant at the 5% level.

Panel B gives the matching results of all multiple awards to the same CEO in the temporary shift framework. The matching estimates for both the quantity and

**Table 4.** Robustness Check 1: Temporary shift model.

| Panel A: First Award | | | | |
|---|---|---|---|---|
| Outcome Variables | N (On Support) | Single Nearest Neighbor Matching Estimate | 10-Neighbors Matching Estimate | Kernel (Gaussian) Matching Estimate |
| $Patent_{t+1}$ | 154 | **0.0836***** (0.0323) | **0.0927***** (0.0237) | **0.0880***** (0.0229) |
| $Patent_{t+2}$ | 149 | **0.1397***** (0.0349) | **0.1169***** (0.0265) | **0.1176***** (0.0255) |
| $Patent_{t+3}$ | 142 | **0.1321***** (0.0387) | **0.1140***** (0.0300) | **0.1082***** (0.0289) |
| $Patent_{t+4}$ | 137 | **0.1305***** (0.0425) | **0.1015***** (0.0328) | **0.1091***** (0.0316) |
| $Citation/Patent_{t+1}$ | 154 | **0.1797***** (0.0801) | **0.1393***** (0.0597) | **0.1192***** (0.0427) |
| $Citation/Patent_{t+2}$ | 149 | **0.1753***** (0.0816) | **0.2009***** (0.0585) | **0.1775***** (0.0560) |
| $Citation/Patent_{t+3}$ | 142 | **0.1712***** (0.0813) | **0.1545***** (0.0608) | **0.1651***** (0.0585) |
| $Citation/Patent_{t+4}$ | 137 | 0.0305 (0.0812) | **0.1300***** (0.0548) | **0.0983**** (0.0445) |
| **Panel B: Multiple Awards** | | | | |
| Outcome Variables | N (On Support) | Single Nearest Neighbor Matching Estimate | 10-Neighbors Matching Estimate | Kernel (Gaussian) Matching Estimate |
| $Patent_{t+1}$ | 243 | **0.1005***** (0.0135) | **0.1104***** (0.0114) | **0.1068***** (0.0116) |
| $Patent_{t+2}$ | 236 | **0.1523***** (0.0317) | **0.1339***** (0.0142) | **0.1309***** (0.0109) |
| $Patent_{t+3}$ | 229 | **0.1163***** (0.0206) | **0.1323***** (0.0174) | **0.1352***** (0.0080) |
| $Patent_{t+4}$ | 222 | **0.1029***** (0.0246) | **0.1451***** (0.0240) | **0.1454***** (0.0137) |
| $Citation/Patent_{t+1}$ | 243 | **0.1347**** (0.0568) | **0.1728***** (0.0354) | **0.1711***** (0.0322) |
| $Citation/Patent_{t+2}$ | 236 | **0.1243**** (0.0609) | **0.1614***** (0.0365) | **0.1978***** (0.0293) |
| $Citation/Patent_{t+3}$ | 229 | **01808***** (0.0659) | **0.1847***** (0.0319) | **0.1874***** (0.0314) |
| $Citation/Patent_{t+4}$ | 222 | **0.1562***** (0.0527) | **0.1017***** (0.0272) | **0.1171***** (0.0254) |

This table presents the results of innovation outputs around actual winners and predicted winners when CEOs' first awards are considered (Panel A) and all multiple awards to the same CEOs (Panel B) are included in the sample in the temporary shift model framework. Predicted winners (P) are selected by a single nearest neighbor, multiple nearest neighbor, and a kernel propensity score matching procedure (with Gaussian kernel function). Matching variables to estimate propensity scores and outcome variables (the number of patents and citations per patent) are described in the **Appendix A** and **Appendix B**. The matching estimates represent differences in the innovation outputs between actual winners and predicted winners. The number of observations in this table only include groups which lie within a common support region. The standard errors are estimated by bootstrapping and are reported in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively.

quality measure of innovation are all significant at the 5% level regardless of which matching algorithms are employed. This confirms that even when a temporary shift in CEO power as a result of winning a high-profile award is assumed, winning such a prestigious award motivates managers to focus more on long-term investments rather than short-term profits, and produces more economically and technically important patents, regardless of whether the award is a CEO's first award or one of many.

#### 4.4.2. The Effect of Winning an Award over the Broader Sample Period

One might argue that the effects of winning a prestigious award on innovation decisions are time-specific. Period-specific factors that are correlated with CEO status and innovation activities in the firm might be omitted. In this section, we investigate whether the award effects on innovation persist outside the sample period. We explore the award effects prior to 1992 as well as over a broader sample period (1976 to 2002). It is important to note that CEO delta and vega measures, CEO age, and tenure are omitted in the first stage of the propensity score matching procedure because Execucomp only provides CEO information from 1992. Even though the exclusion of CEO variables in the first stage might affect the propensity score and estimates of a treatment effect, this sub-sample period analysis provides an opportunity to explore whether or not award effects are time-sensitive.

**Table 5** reports matching estimates in the permanent shift framework over the period from 1976 to 1991 and over the entire period 1976 to 2002[11]. Similar to the findings in previous analyses, award-winning effects are highly significant at the 1% level over the broader sample period (1976 to 2002) and the effects remain significantly persistent even over the early period (periods prior to 1992), regardless of which matching algorithm is used. The results in **Table 5** suggest that CEOs who win awards innovate more compared to similar CEOs, even during the earlier period and that the effects, therefore, are not time-specific.

#### 4.4.3. Other Robustness Checks

We also perform other robustness checks. First, we exclude award-winners who leave or retire from their company within two years of receiving an award. If a CEO who wins a prestigious award knows that he/she will leave the company soon or if he/she wants to move to another company, he/she does not have a strong incentive to pursue long-term and innovative projects and could choose to focus on short-term profits. Second, in the propensity score matching procedure, we use a variety of nearest neighbors (e.g., 5, 20, and 50) instead of a 10-multiple nearest neighbor matching. In addition, instead of a Gaussian function we also implement a variety of kernel weighting schemes such as biweight, Epanechnikov, uniform, tricube kernel functions, and local linear weighting scheme. The results

[11]The estimates of the 10-nearest neighbor matching is not reported in the table due to brevity. The results are very similar to other matching methods. We also implement a propensity score matching in the temporary shift model framework over the broader sample periods. The results are very similar to the permanent shift model.

**Table 5.** Robustness Check 2: Subsample periods analysis.

| | Period: 1976-1991 | | | Period: 1976-2002 | | |
|---|---|---|---|---|---|---|
| Outcome Variables | N (On Support) | Single Nearest Neighbor | Kernel (Gaussian) | N (On Support) | Single Nearest Neighbor | Kernel (Gaussian) |
| | | Matching Estimate | Matching Estimate | | Matching Estimate | Matching Estimate |
| $Patent_{t+1}$ | 632 | **0.0993*****<br>(0.0137) | **0.1063*****<br>(0.0078) | 2187 | **0.1106*****<br>(0.0102) | **0.1176*****<br>(0.0059) |
| $Patent_{t+2}$ | 623 | **0.1017*****<br>(0.0141) | **0.1211*****<br>(0.0056) | 2131 | **0.1291*****<br>(0.0114) | **0.1343*****<br>(0.0066) |
| $Patent_{t+3}$ | 613 | **0.1254*****<br>(0.0112) | **0.1421*****<br>(0.0075) | 2075 | **0.1436*****<br>(0.0124) | **0.1504*****<br>(0.0074) |
| $Patent_{t+4}$ | 600 | **0.1647*****<br>(0.0198) | **0.1617*****<br>(0.0080) | 2020 | **0.1563*****<br>(0.0138) | **0.1630*****<br>(0.0082) |
| $Citation/Patent_{t+1}$ | 632 | **0.1017*****<br>(0.0359) | **0.1214*****<br>(0.0140) | 2188 | **0.1244*****<br>(0.0248) | **0.1238*****<br>(0.0077) |
| $Citation/Patent_{t+2}$ | 624 | **0.1211*****<br>(0.0276) | **0.1204*****<br>(0.0134) | 2134 | **0.1158*****<br>(0.0243) | **0.1296*****<br>(0.0084) |
| $Citation/Patent_{t+3}$ | 615 | **0.1581*****<br>(0.0307) | **0.1210*****<br>(0.0160) | 2079 | **0.1441*****<br>(0.0233) | **0.1281*****<br>(0.0076) |
| $Citation/Patent_{t+4}$ | 602 | **0.1091*****<br>(0.0358) | **0.1371*****<br>(0.0145) | 2025 | **0.1563*****<br>(0.0231) | **0.1271*****<br>(0.01030) |

This table presents award-winning effects on long-run innovation decisions over the periods beginning in 1976. Panel A shows treatment effects, in the permanent shift model, over the period 1976-1991 and the period 1976-2002. Panel B reports award-winning effects on innovation over the two periods when the temporary effects on winning an award are assumed. The division of the sample periods is based on availability of CEO information from Execucomp database. Matched groups for each treatment group are selected by a single nearest neighbor, 10-nearest neighbors (not reported), and kernel propensity score matching procedure (with Gaussian kernel function). The outcome variables are the number of patents (scaled by the average number of patents in the same year) and the number of citations per patent. The matching estimates represent differences in the innovation outputs between actual winners and predicted winners. The number of observations in this table only include groups which lie within a common support region. The standard errors are estimated by bootstrapping and are reported in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively.

for both cases remain very similar in the sense that award-winners innovate more than predicted award-winners.

#### 4.4.4. Two-Stage Regression Model: Controlling for Endogeneity

In the previous section, we perform a propensity score matching to examine the effect of winning an award on a CEO's innovation decisions. As discussed by Malmendier and Tate (2009), CEO awards are a good application of propensity score matching because those awards are conferred by corporate outsiders who select award-winners based on public information. Nonetheless, the positive effect of winning an award on innovation might be more rigorous if the same result existed in a regression framework. The standard linear regression, however, might be problematic because it may suffer from a potential endogeneity problem that arises from selection bias. Award-winners who achieved outstanding success in the past may want to continue to perform well through more innovation. Therefore, one should investigate whether winning prestigious awards provide good-performing CEOs with additional incentives for innovation, compared to similar good-performing CEOs who did not win the awards. To overcome the selection bias problem, we implement a two-stage least squares (2SLS) instrumental variable (IV) design. The model includes two steps:

$$\text{Award} = \alpha \Pi \varepsilon', \tag{1}$$

where $\varepsilon' \sim N\left(0, \sigma'^2\right)$

$$Y = \gamma_0 + \gamma_1 X + \gamma_2 \text{Award} + \varepsilon, \tag{2}$$

where $\varepsilon \sim N\left(0, \sigma'^2\right)$.

In Selection Equation (1), the model estimates the probability of winning an award for each CEO/firm group by regressing the award dummy variable (Award) on a set of CEO/firm characteristics ($\Pi$) that predict the likelihood of winning an award. We include 1-year Carhart's four-factor risk-adjusted stock returns prior to an award, log(market capitalization), book-to-market, log(CEO age), and log(1 + CEO tenure) as explanatory variables in the first equation. In equation (2), the model regresses innovation outcomes year $t + 1$ to year $t + 4$ on the estimated probability of winning an award in the selection equation along with a set of variables that affect innovation ($X$). We include log(sales), R&D/assets, leverage, tangibility, profitability, cash/assets, log(1 + firm age), log(1 + CEO delta), log(1 + CEO vega), log(1 + CEO tenure), and log(CEO age) in the set of variables that affect innovation. Importantly, to further eliminate a potential omitted variable problem, we include lagged patenting outcomes and run a regression in the firm fixed effects framework. We believe that including lagged patenting outcomes and employing a firm fixed effects approach help control for any remaining firm-level omitted variable bias[12]. To control for any macroeconomic shocks, year dummies are also included in the regression.

Table 6 provides estimates of the 2SLS IV model. When the quantity of innovation is a dependent variable in the second stage regression, the award variables are all positive during the four years following the award. The award variables are statistically significant at the 5% level for the first three years and the award variable in year $t + 4$ is close to the cutoff of significance at 10% level ($t = 1.58$). When the quality of innovation is examined, the award variables are all significantly positive at the 10% level but the award variable in year $t + 4$ is not significant. The results in Table 6 demonstrate that, after dealing with a potential selection bias, award-winning CEOs, on average, produce more and better-quality patents. In other words, winning a high-profile award encourages CEOs to invest in

[12]We also implement industry fixed effects instead of firm fixed effects. Both the economic magnitude and statistical significance of the award variable become stronger when industry fixed-effects model is employed.

**Table 6.** Robustness Check 3: 2SLS instrumental variable model.

| Variable | $Ln(1 + Pat_{t+1})$ | $Ln(1 + Pat_{t+2})$ | $Ln(1 + Pat_{t+3})$ | $Ln(1 + Pat_{t+4})$ | $Ln(1 + \frac{Cit}{Pat_{t+1}})$ | $Ln(1 + \frac{Cit}{Pat_{t+2}})$ | $Ln(1 + \frac{Cit}{Pat_{t+3}})$ | $Ln(1 + \frac{Cit}{Pat_{t+4}})$ |
|---|---|---|---|---|---|---|---|---|
| Award | **0.0846***** | **0.108***** | **0.0774**** | 0.0526 | **0.0664*** | **0.0894***** | **0.0625*** | −0.0151 |
| | (0.0275) | (0.0295) | (0.0317) | (0.0333) | (0.0344) | (0.0344) | (0.0350) | (0.0361) |
| $Ln(1 + Pat_{t-1})$ | 0.751*** | 0.555*** | 0.266*** | 0.0107 | | | | |
| | (0.0252) | (0.0297) | (0.0338) | (0.0378) | | | | |
| $Ln(1 + Cit/Pat_{t-1})$ | | | | | 0.586*** | 0.346*** | −0.0118 | −0.234*** |
| | | | | | (0.0284) | (0.0288) | (0.0327) | (0.0367) |
| Ln(Sales) | 0.0362*** | 0.0237*** | 0.0174*** | 0.0162** | 0.0116** | 0.0137** | 0.0172*** | 0.0260*** |
| | (0.00484) | (0.00548) | (0.00634) | (0.00713) | (0.00583) | (0.00595) | (0.00637) | (0.00690) |
| R&D | 0.0680 | 0.150 | 0.326*** | 0.294** | 0.602*** | 0.818*** | 0.848*** | 0.435*** |
| | (0.0814) | (0.0916) | (0.103) | (0.116) | (0.0995) | (0.102) | (0.108) | (0.117) |
| Leverage | −0.0639*** | −0.0649*** | −0.0609** | −0.0644** | −0.0413* | −0.0500** | −0.0725*** | −0.0482* |
| | (0.0191) | (0.0216) | (0.0250) | (0.0284) | (0.0231) | (0.0236) | (0.0254) | (0.0275) |
| Tangibility | 0.0788*** | 0.0774** | 0.0792** | 0.0908** | 0.0906** | 0.123*** | 0.101*** | 0.0954** |
| | (0.0292) | (0.0326) | (0.0369) | (0.0411) | (0.0356) | (0.0360) | (0.0380) | (0.0408) |
| Profitability | −0.0761*** | 0.00899 | 0.0990*** | 0.145*** | 0.112*** | 0.228*** | 0.328*** | 0.351*** |
| | (0.0295) | (0.0328) | (0.0372) | (0.0417) | (0.0361) | (0.0369) | (0.0390) | (0.0418) |
| Cash | −0.0123 | 0.00312 | 0.0326 | 0.00471 | 0.0225 | 0.0195 | −0.0226 | 0.00583 |
| | (0.0268) | (0.0303) | (0.0354) | (0.0401) | (0.0325) | (0.0330) | (0.0354) | (0.0387) |
| Ln(1 + Firm age) | 0.0551*** | 0.0560*** | 0.0565*** | 0.0467*** | −0.0187** | −0.0226** | −0.0153 | −0.0147 |
| | (0.00780) | (0.00890) | (0.0104) | (0.0116) | (0.00930) | (0.00938) | (0.0101) | (0.0111) |
| Ln(1 + CEO delta) | 0.00684*** | 0.00450* | −9.67e−05 | −0.00173 | 0.00983*** | 0.00933*** | 0.00113 | −0.00145 |
| | (0.00241) | (0.00271) | (0.00310) | (0.00342) | (0.00292) | (0.00296) | (0.00316) | (0.00341) |
| Ln(1 + CEO vega) | 0.00411** | 0.00469** | 0.00503* | 0.00189 | −0.000761 | −0.00302 | 0.00388 | 0.00333 |
| | (0.00203) | (0.00230) | (0.00264) | (0.00290) | (0.00244) | (0.00247) | (0.00266) | (0.00288) |
| Ln(1 + CEO tenure) | 0.000604 | −0.00210 | 0.00131 | 0.00409 | −0.00448 | −0.0102** | −0.00221 | 0.00231 |
| | (0.00324) | (0.00363) | (0.00412) | (0.00460) | (0.00395) | (0.00401) | (0.00424) | (0.00455) |
| Ln(1 + CEO age) | −0.0438 | −0.0758** | −0.0795** | −0.0800* | −0.0336 | −0.00354 | 0.0119 | 0.0272 |
| | (0.0266) | (0.0306) | (0.0357) | (0.0413) | (0.0321) | (0.0327) | (0.0350) | (0.0385) |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 17,796 | 15,622 | 13,513 | 11,545 | 18,974 | 18,015 | 15,963 | 13,934 |

This table reports estimates of the effects of winning an award on innovation outcomes in the 2SLS model. This regression model includes two steps. In the first step, it runs a probit regression in which the dependent variable is an award dummy in the permanent shift model and the independent variables are 1-year Carhart's four-factor risk-adjusted stock returns prior to an award, log(market capitalization), book-to-market, log(CEO age), log(1 + CEO tenure). The estimated probability of winning an award for each observation is included in the second stage as a key independent variable (Award) where the dependent variable is innovation outcomes year $t+1$ to year $t+4$. I also include control variables that affect a firm's innovation decisions in the second stage. To further control an omitted variable bias problem, we include lagged patenting activities and firm dummies in the regression. All continuous variables are winsorized at the 1% level. Standard errors are reported in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively.

long-term, risky, and innovative projects and helps mitigate any managerial incentives to make myopic investment decisions. The results in **Table 6** confirm the finding of a positive effect of winning a high-profile award on innovation and it holds even in the parametric regression framework.

## 5. Sources of the Positive Award-Winning Effect on Innovation

The evidence presented in Section 4 suggests that winning a prestigious award helps CEOs focus on long-term growth rather than short-term earnings. In this section, we investigate the channel through which winning a prestigious award fuels innovation. Based on the managerial flexibility hypothesis, greater power given to CEOs after a prestigious award incentivizes them to pursue long-term, innovative projects since a shift in CEO power helps insulate them from the risk of job dismissal. On the other hand, the overconfidence hypothesis predicts that CEOs' psychological biases as a result of receiving an award are the driving force for the positive effect.

### 5.1. Do Award-Winning CEOs Become More Powerful?

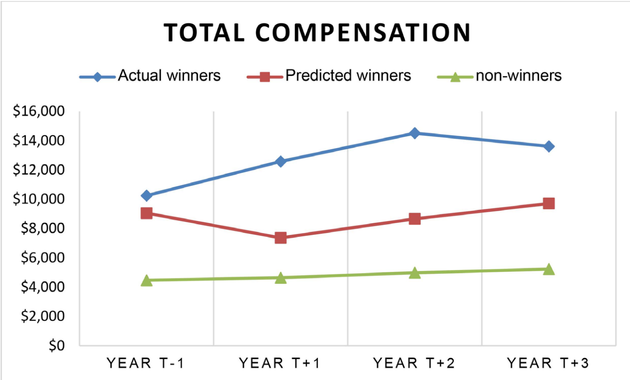
We explore whether award-winning CEOs become more powerful (and, in turn, more entrenched) in two ways: CEO compensation and CEO turnover-performance sensitivity. In these analyses, in addition to the award-winners in the sample from 1992 to 2002, we include more recent award winners up to 2011 for the CEO compensation analysis and up to 2006 for the CEO turnover-performance sensitivity analysis.

First, we examine whether CEOs extract rents after winning an award during the sample period 1992-2011[13]. **Figure 2** plots CEO total compensation between actual award-winners, predicted winners, and non-winners[14]. **Figure 2** shows that total compensation of award-winning CEOs substantially increases by about 40% over the two years following an award while predicted winners' compensation slightly decreases by about 8% over the same period.

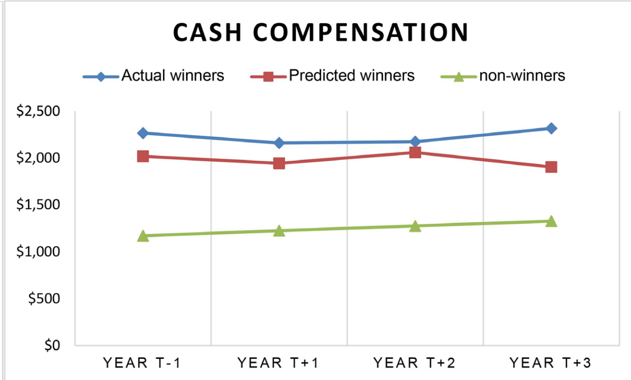
We quantify the increases in CEO compensation and report the results in Panel A of **Table 7**. Award-winners not only receive higher compensation than similar CEOs who do not win awards, but they also enjoy more increases in compensation after their awards than similar CEOs. The differences in compensation increases

[13]Malmendier and Tate's (2009) analysis for rent extraction is based on award-winners from the period 1992-2002 while our analysis covers award-winners up to 2011.

[14]Predicted winners are chosen by the propensity score matching technique. We use firm size, returns, CEO gender, CEO age, and CEO tenure as matching variables that might affect one's propensity to win a prestigious award. We also use reported determinants of CEO compensation by prior executive compensation literature as a matching variable: ROA, sales growth, cash, firm risk, and CEO/chairman duality (Core, Guay, and Larcker, 2008; Core, Holthausen, and Larcker, 1999; Murphy, 1999; Rose and Shepard, 1997). Award winners and predicted winners are matched within the same year and same industry group at the two-digit SIC level. To further eliminate heterogeneity for CEO total compensation between actual winners and predicted winners at year $t-1$, I sort the sample CEOs into deciles of total compensation and then we force actual award-winners and predicted winners to match within the same decile.




(a)




(b)

**Figure 2.** Mean CEO total and cash compensation. The graph plots mean CEO total and cash compensation for first-time award-winners, predicted winners, and non-winners based on the sample data from 1992 to 2011. CEO total compensation (tdc1 from Execucomp) is the sum of salary, bonus, other annual compensation, restricted stock grants, LTIP payouts, options grants, and all other total compensation. The total compensation is reported in increments of $1000.

**Table 7.** CEO award, CEO power, and job security.

**Panel A: Changes in compensation**

| Outcome variables | N (on support) | Nearest-neighbor matching | | | Kernel matching | | |
|---|---|---|---|---|---|---|---|
| | | Award winners (W) | Predicted winners (P) | Difference (W-P) | Award winners (W) | Predicted winners (P) | Difference (W-P) |
| Δtotal compensation $[t-1, t+1]$ | 165 | $2175.92 | −$2413.69 | $4589.54*** | $2175.92 | −$1745.10 | $3921.02*** |
| | | | | ($1654.89) | | | ($1480.58) |
| Δtotal compensation $[t-1, t+2]$ | 138 | $3534.47 | −$1490.99 | $5025.46*** | $3534.47 | −$1438.82 | $4973.29*** |
| | | | | ($2268.85) | | | ($1650.46) |
| Δexcess compensation $[t-1, t+1]$ | 192 | $1705.46 | −$1839.61 | $3545.37* | $1705.46 | −$1950.78 | $3656.54*** |
| | | | | ($2000.71) | | | ($1667.55) |
| Δexcess compensation $[t-1, t+2]$ | 178 | $2251.53 | −$5096.51 | $7321.04*** | $2251.53 | −$2204.70 | $4456.22*** |
| | | | | ($1946.46) | | | ($1431.50) |

**Panel B: Multinomial logit regression: Post-CEO turnover after awards**

| Variable | Year $t+1$ | | | Year $t+2$ | | |
|---|---|---|---|---|---|---|
| | Exogenous | Unclassified | Forced | Exogenous | Unclassified | Forced |
| First award dummy | −0.627 | 0.132 | −0.196 | −0.0838 | −0.447 | −1.057 |
| | (0.633) | (0.384) | (0.728) | (0.476) | (0.527) | (1.001) |
| Poor performance dummy | −0.399** | 0.0946 | 0.541*** | 0.121 | 0.218* | −0.144 |
| | (0.177) | (0.114) | (0.186) | (0.182) | (0.129) | (0.250) |
| **(First award)* (Poor performance)** | 1.872* | −0.405 | **−11.38*****| 0.704 | **−10.60***** | **−9.887***** |
| | (0.996) | (1.161) | (0.829) | (1.072) | (0.634) | (1.118) |
| Industry-adjusted Return | −0.396 | 0.123 | −1.740** | 0.590 | 0.307 | 0.776 |
| | (0.617) | (0.448) | (0.813) | (0.626) | (0.465) | (0.964) |

**Continued**

| | | | | | | |
|---|---|---|---|---|---|---|
| Industry Return | 0.151 | −0.328 | −1.602 | 0.688 | −0.465 | 2.248* |
| | (0.894) | (0.572) | (1.066) | (0.875) | (0.616) | (1.237) |
| Industry-adjusted ROA | −0.937 | −0.569 | −1.005 | 0.897 | −0.630 | −1.751* |
| | (1.108) | (0.587) | (0.986) | (1.145) | (0.597) | (0.952) |
| Industry ROA | −0.341 | −0.334 | −1.301 | 0.314 | −0.473 | −1.364 |
| | (1.252) | (0.712) | (1.261) | (1.301) | (0.780) | (1.392) |
| Log(Asset) | 0.184*** | 0.0740** | 0.324*** | 0.171*** | 0.0950*** | 0.308*** |
| | (0.0413) | (0.0298) | (0.0544) | (0.0434) | (0.0326) | (0.0593) |
| Log(CEO age) | 8.246*** | 3.740*** | −1.076 | 8.141*** | 4.116*** | −1.218 |
| | (0.642) | (0.420) | (0.683) | (0.692) | (0.468) | (0.795) |
| Log (Tenure) | 0.1000 | 0.0688 | −0.0272 | 0.123* | 0.0557 | −0.0940 |
| | (0.0613) | (0.0445) | (0.0803) | (0.0691) | (0.0513) | (0.0968) |
| CEO/Chairman duality | −2.253*** | −2.748*** | −4.601*** | −2.383*** | −2.789*** | −4.579*** |
| | (0.223) | (0.223) | (1.003) | (0.241) | (0.236) | (1.002) |
| Industry fixed effects | | Yes | | | Yes | |
| Year fixed effects | | Yes | | | Yes | |
| Pseudo $R^2$ | | 15.26% | | | 16.18% | |
| Observations | | 14,165 | | | 11,909 | |

This table presents how a shift in CEO power as a result of winning a prestigious award affects CEO total compensation and CEO turnover. Panel A reports a propensity score matching result on a change in CEO total compensation between first-time award-winners and predicted winners. In the first stage, we estimate a propensity score in which a dependent variable is a first-award indicator variable (one for all CEO-year observations after year *t* when CEOs win their first-time award and zero otherwise). The independent variables used as a matching variable are log(asset), $\text{return}_{t-1}$, $\text{return}_t$, $\text{ROA}_{t-1}$, $\text{ROA}_t$, sales growth, cash, firm risk, log(CEO age), log(1 + CEO tenure), CEO gender, and CEO/chairman duality (along with year dummies and industry dummies at the two-digit SIC level). In the second stage, the predicted award-winners are selected in the same year and same industry group at two-digit SIC level with award-winners by using a single nearest neighbor and a kernel propensity score matching algorithm. To further eliminate heterogeneity of total compensation between actual winners and predicted winners, we sort the sample CEOs into deciles of compensation, and then we force actual winners and predicted winners to match within the same decile group. The outcome variables are (excess) total compensation (tdc1 measure from Execucomp). We estimate excess compensation following the estimation method by Core, Guay, and Larcker (2008). They first estimate expected compensation using the following regression, and calculate excess compensation by subtracting the expected compensation from the total compensation. $\text{Log}(\text{compensation})_t = \beta_0 + \beta_1 \text{Log}(\text{sales})_{t-1} + \beta_2 \text{Ret}_t + \beta_3 \text{Ret}_{t-1} + \beta_4 \text{ROA}_t + \beta_5 \text{ROA}_{t-1} + \beta_6 \text{BM}_{t-1} + \beta_7 \text{S\&P500}_t + \beta_8 \text{Log}(\text{tenure})_t + \beta_9 \text{Industry dummy} + \beta_{10} \text{year dummy}$. The number of observations in this table only include groups which lie within a common support region. The standard errors are estimated by bootstrapping and are reported in parentheses. Panel B presents multinomial logistic regression results on how winning an award affects CEO turnover. The dependent variable is a CEO turnover equal to one for exogenous turnover (scheduled retirement, death, etc.), equal to two for unclassified turnover, equal to three for forced turnover (fired by the board), and equal to zero for no turnover events. Thus, the reference category is no turnover events. The poor performance dummy is equal to one if a firm belongs to the bottom 25% group based on industry-adjusted ROA and zero otherwise. The interest variable in the regression is an interaction term between the first award dummy and poor performance dummy. All other variables are described in the **Appendix A**. The standard errors are clustered at the group (CEO/firm) level. ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively.

around the time of the awards between award-winners and predicted winners are significant at the 1% level. One might argue that award-winners are compensated more because they perform better than similar CEOs or that it might be the optimal decision for a firm to pay its CEO more as a way of incentivizing him/her to maximize firm value. Thus, it is necessary to eliminate potential factors that affect CEO compensation. Core, Guay, and Larcker (2008) estimate excess compensation using a two-stage method. First, they estimate expected compensation by regressing log(compensation) on log(sales), contemporaneous and lagged returns and ROA, book-to-market, S&P 500 indicator variable, and log(tenure) along with year- and industry-fixed effects. Second, they compute excess compensation by adjusting estimated expected compensation. The results for Panel A also suggest that award-winners receive significantly more increased compensation than benchmark CEOs during the period between year $t-1$ and year $t+2$.

The evidence of an immediate jump in compensation over the first two years following the award suggests that superstar CEOs extract a higher compensation using their increased power as a result of winning an award, both relative to their own compensation before winning an award and relative to that of predicted winners. In contrast to total compensation, however, in **Figure 2**, there is no significant difference in cash compensation between award-winners and similar CEOs in the regression (not tabulated). Evidence of a heterogeneous pattern for compensation is consistent with Malmendier and Tate's finding. They suggest that award-winning CEOs extract rents mostly from equity compensation to avoid potential shareholder outrage because equity compensations are less transparent to shareholders than cash compensations.

Award-winning CEOs are also likely to have lower CEO performance-turnover sensitivity after winning an award because they become more visible to the public and, as a result, the boards are more likely to be susceptible to shareholder voice (Fisman et al., 2013). We use CEO turnover data from the period 1992-2006 from Camelia Kuhnen's website. We implement a multinomial logistic regression to examine whether winning an award affects CEO turnover[15]. The dependent variable is CEO turnover which is equal to one for exogenous turnover (e.g., scheduled retirement, death, etc.), equal to two for unclassified turnover, equal to three for forced turnover, and equal to zero for no turnover events. Thus, the reference category in the regression is no turnover events. Since we are interested in the question of whether award-winning CEOs are fired when they underperform less frequently than similar CEOs who do not win awards, we include a poor performance dummy, which is equal to one if a firm is in the bottom 25% of the sample firms based on industry-adjusted ROA in a given year and zero otherwise. The interest variable in the regression is an interaction term between the award

[15]We implement a multinomial logit regression, rather than a propensity score matching because CEO turnover is a very rare event. In our sample, only two award-winning CEOs were fired by boards in the year of their award. Therefore, a small change in the number of forced turnover events in the predicted winner group will substantially swing the estimates of the difference in forced turnover rate between award-winners and predicted winners.

dummy and the poor performance dummy. All other variables in Panel B of **Table 7** are described in **Appendix A**.

We find evidence that award-winning CEOs are less likely to be fired by boards (and are even less likely to leave the firm for unclassified reasons) relative to non-winning CEOs, even though they underperform. The interaction term between the award dummy and the poor-performance dummy is significantly negative at the 1% level for forced turnover during the first two years following the award. In terms of the economic magnitude of the effect of winning an award on CEO turnover, award-winning CEOs are 10 times less likely to be fired than similar CEOs when they underperform. The evidence in Panel B demonstrates that boards are reluctant to fire award-winning CEOs even though they underperform.

In sum, the evidence in **Table 7** suggests that there is a clear shift in CEO power in the firm after a CEO wins a prestigious award and that the CEO tends to extract rent (consistent with Malmendier and Tate, 2009) and to enjoy greater job security. In other words, CEOs become more powerful and face a lower threat of dismissal after receiving an award, and this job security might drive CEOs to pursue long-term growth opportunities rather than short-term profits. Therefore, the evidence from **Table 7** is consistent with the managerial flexibility hypothesis.

### 5.2. Do Award-Winning CEOs Become Overconfident?

It is possible that winning a high-profile award not only shifts power towards CEOs but may also change aspects of their psychology. Recent corporate finance literature has focused on the effect of managerial overconfidence on firm decisions and its corresponding consequences. Overconfidence is the tendency of individuals to overestimate their abilities and forecast future outcomes unreasonably optimistically. CEO awards are conferred by corporate outsiders such as prominent nation-wide magazines which are considered more reliable institutions than individuals. Thus, winning such a prestigious award might bias CEOs' beliefs about their skills and abilities and affect the extent to which they are optimistic about their future outcomes on investments.

Related to CEO overconfidence and innovation, Hirshleifer et al. (2012) show that firms with overconfident CEOs (proxied by options- and press-based measures) invest more in innovation, obtain more patents and patent citations, and achieve greater innovative success for given R&D expenditures. As winning an award can make CEOs overconfident and because managerial overconfidence is positively associated with patenting activities, one might argue that being overconfident after winning an award drives the positive effects of the award on innovation. Therefore, it is important to determine how winning a prestigious award changes CEO overconfidence and how this change in biased beliefs in turn affects innovation decisions.

We estimate a CEO overconfidence measure based on managerial options following the previous literature (Campbell, Gallmeyer, Johnson, Rutherford, and Stanley, 2011; Hirshleifer, Low, and Teoh, 2012). The overconfidence variable is an indicator variable which is equal to one if a CEO does not exercise stock options that are more than 67% in the money and zero otherwise. We first examine whether receiving a prestigious award affects a CEO's overconfidence. Among the award-winners in the sample between 1992 and 2011 (218 unique award-winners with a non-missing overconfidence variable), only about 3% of winners (6 winners) become overconfident during their tenures after the awards[16]. Winning a prestigious award does not change an overconfidence trait for the majority of the award-winners in the sample. To quantify the effect of winning an award on overconfidence, we run a regression in which the dependent variable is an indicator variable of whether a CEO becomes overconfident within the next four years in a given year *t*. For award-winners, the dependent variable is one if a CEO becomes overconfident within the four years following the award. A key independent variable is the award dummy which is equal to one if a CEO receives an award at year *t* and zero otherwise. We also employ several control variables which are reported to affect CEO option exercise: $\text{return}_{t-1}$, $\text{return}_{t-2}$, $\log(\text{asset})_{t-1}$, $\text{ROA}_{t-1}$, $\text{ROA}_{t-2}$, $\text{sale growth}_{t-1}$, $\text{cash}_{t-1}$, $\text{volatility}_{t-1}$, $\log(1 + \text{CEO age})_{t-1}$, female dummy, and CEO/chairman duality, along with year fixed effects and industry fixed effects.

Panel A of **Table 8** provides the results. The award variable is statistically insignificant, indicating that winning a prestigious award does not have a meaningful effect on managerial overconfidence. The evidence in **Table 8** suggests that overconfidence is not the main source of the positive effect on innovation.

We further investigate whether the effect of the award on innovation still remains significant after eliminating the effects of pre-existing managerial overconfidence prior to receiving an award. To determine this, we employ both a propensity score matching and a two-stage regression approach during the sample period 1992-2002. In the propensity score matching, we partition the sample into two groups (firms with vs. firms without overconfident CEOs) and we rematch actual award-winners with non-winners within each group. The results of the propensity score matching analysis (not tabulated) suggests that even after controlling for the CEO overconfidence effect, award-winners still produce more and better quality patents than the predicted winners, and the estimates of the difference between the two groups are significant at the 1% level. In a two-stage selection model, we include an overconfidence variable as an additional explanatory variable. The result of the two-stage regression (Panel B of **Table 8**) shows that there are still significantly positive effects of winning an award on patenting activities for the first three years following the award, even after controlling for the CEO overconfidence effect. The economic magnitude and statistical significance are quite similar to previous results without controlling for overconfidence. The evidence in **Table 8** suggests that the positive effects of receiving a prestigious award on innovation outcomes are not mainly driven by CEO overconfidence, and the effects still exist even after controlling for the effect of overconfidence on innovation.

[16]160 award-winners (73.4% of the winners in the sample) are already overconfident before winning an award while 52 award-winners (23.9% of the winners) remain less confident regardless of winning an award.

**Table 8.** Post innovation to CEO awards after controlling for CEO overconfidence.

| Panel A: CEO award and overconfidence | |
|---|---|
| Variables | Overconfidence |
| Award dummy | 0.837 |
| | (0.627) |
| $\text{Return}_{t-1}$ | −0.520 |
| | (0.674) |
| $\text{Return}_{t-2}$ | −0.440 |
| | (0.707) |
| $\text{Ln(Asset)}_{t-1}$ | −0.235*** |
| | (0.0674) |
| $\text{ROA}_{t-1}$ | 1.804** |
| | (0.894) |
| $\text{ROA}_{t-2}$ | −2.062** |
| | (0.941) |
| $\text{Sale growth}_{t-1}$ | −0.666* |
| | (0.356) |
| $\text{Cash}_{t-1}$ | −0.283* |
| | (0.170) |
| $\text{Volatility}_{t-1}$ | 5.260*** |
| | (1.940) |
| $\text{Ln(1 + CEO age)}_{t-1}$ | −0.958 |
| | (0.675) |
| Female | −0.952 |
| | (1.022) |
| Duality | −0.00216 |
| | (0.181) |
| Year fixed effects | Yes |
| Industry fixed effects | Yes |
| No. of obs. | 6805 |

| Panel B: 2SLS IV Approach: The effect of the award on innovation after controlling for CEO overconfidence | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | $\text{Ln}(1 + \text{Pat}_{t+1})$ | $\text{Ln}(1 + \text{Pat}_{t+2})$ | $\text{Ln}(1 + \text{Pat}_{t+3})$ | $\text{Ln}(1 + \text{Pat}_{t+4})$ | $\text{Ln}(1 + \frac{\text{Cit}}{\text{Pat}_{t+1}})$ | $\text{Ln}(1 + \frac{\text{Cit}}{\text{Pat}_{t+2}})$ | $\text{Ln}(1 + \frac{\text{Cit}}{\text{Pat}_{t+3}})$ | $\text{Ln}(1 + \frac{\text{Cit}}{\text{Pat}_{t+4}})$ |
| Award | **0.0841*** ** | **0.1075*** ** | **0.0760** ** | 0.0515 | **0.0652*** | **0.0881** ** | **0.0606*** | −0.0161 |
| | (0.0275) | (0.0295) | (0.0317) | (0.0333) | (0.0344) | (0.0344) | (0.0350) | (0.0361) |
| Overconfidence | 0.0090 | 0.0116* | 0.0236*** | 0.0355*** | 0.0133* | 0.0209*** | 0.0264*** | 0.0186** |
| | (0.0059) | (0.0066) | (0.0075) | (0.0085) | (0.0072) | (0.0072) | (0.0076) | (0.0082) |
| $\text{Ln}(1 + \text{Pat}_t)$ | 0.7507*** | 0.5549*** | 0.2656*** | 0.0110 | | | | |
| | (0.0252) | (0.0297) | (0.0339) | (0.0378) | | | | |

**Continued**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ln(1 + Cit/Pat$_t$) | | | | | 0.5855*** | 0.3449*** | −0.0121 | −0.2343*** |
| | | | | | (0.0284) | (0.0288) | (0.0327) | (0.0367) |
| Ln(Sales) | 0.0366*** | 0.0241*** | 0.0182*** | 0.0169** | 0.0122** | 0.0147** | 0.0185*** | 0.0268** |
| | (0.0048) | (0.0055) | (0.0063) | (0.0071) | (0.0058) | (0.0060) | (0.0064) | (0.0069) |
| R&D | 0.0673 | 0.1499 | 0.3247*** | 0.2907** | 0.6014*** | 0.8177*** | 0.8459*** | 0.4340*** |
| | (0.0814) | (0.0916) | (0.1033) | (0.1161) | (0.0995) | (0.1022) | (0.1077) | (0.1168) |
| Leverage | −0.0641*** | −0.0653*** | −0.0612** | −0.0640** | −0.0416* | −0.0507** | −0.0734*** | −0.0490* |
| | (0.0191) | (0.0216) | (0.0250) | (0.0284) | (0.0231) | (0.0236) | (0.0254) | (0.0275) |
| Tangibility | 0.0796*** | 0.0781*** | 0.0803** | 0.0927** | 0.0917*** | 0.1250*** | 0.1033*** | 0.0964** |
| | (0.0292) | (0.0326) | (0.0369) | (0.0410) | (0.0356) | (0.0360) | (0.0380) | (0.0408) |
| Profitability | −0.0772*** | 0.0074 | 0.0965*** | 0.1419*** | 0.1099*** | 0.2241*** | 0.3245*** | 0.3487*** |
| | (0.0295) | (0.0328) | (0.0372) | (0.0417) | (0.0362) | (0.0369) | (0.0390) | (0.0418) |
| Cash | −0.0133 | 0.0017 | 0.0292 | −0.0005 | 0.0215 | 0.0183 | −0.0250 | 0.0035 |
| | (0.0268) | (0.0304) | (0.0354) | (0.0401) | (0.0325) | (0.0330) | (0.0353) | (0.0387) |
| Ln(1 + Firm age) | 0.0551*** | 0.0558*** | 0.0558*** | 0.0455*** | −0.0185** | −0.0225** | −0.0157 | −0.0153* |
| | (0.0078) | (0.0089) | (0.0104) | (0.0116) | (0.0093) | (0.0094) | (0.0101) | (0.0111) |
| Ln(1 + CEO delta) | 0.0068*** | 0.0045* | −0.0001 | −0.0017 | 0.0097*** | 0.0092*** | 0.0010 | −0.0015 |
| | (0.0024) | (0.0027) | (0.0031) | (0.0034) | (0.0029) | (0.0030) | (0.0032) | (0.0034) |
| Ln(1 + CEO vega) | 0.0038* | 0.0042* | 0.0039 | 0.0002 | −0.0012 | −0.0038 | 0.0028 | 0.0025 |
| | (0.0020) | (0.0023) | (0.0027) | (0.0029) | (0.0025) | (0.0025) | (0.0027) | (0.0029) |
| Ln(1 + CEO tenure) | −0.0007 | −0.0039 | −0.0024 | −0.0015 | −0.0065 | −0.0135*** | −0.0063 | −0.0007 |
| | (0.0034) | (0.0038) | (0.0043) | (0.0048) | (0.0040) | (0.0041) | (0.0044) | (0.0047) |
| Ln(1 + CEO age) | −0.0456* | −0.0778** | −0.0833** | −0.0863** | −0.0364 | −0.0073 | 0.0076 | 0.0250 |
| | (0.0267) | (0.0306) | (0.0357) | (0.0413) | (0.0321) | (0.0327) | (0.0350) | (0.0385) |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of obs. | 17,796 | 15,622 | 13,513 | 11,545 | 18,974 | 18,015 | 15,963 | 13,934 |

This table shows results of the role managerial overconfidence plays in explaining the observed results in Section 4. Panel A presents a logit regression examining whether receiving a prestigious award affects managerial overconfidence. The dependent variable is an indicator variable of whether a CEO becomes overconfident within four years in a given year $t$. For award-winners, the dependent variable is one if a CEO becomes overconfident within four years following the award. A key independent variable is the award dummy which is equal to one if a CEO receives an award at year $t$ and zero otherwise. We also employ several control variables which are reported to affect CEO option exercise: return$_{t-1}$, return$_{t-2}$, log (asset)$_{t-1}$, ROA$_{t-1}$, ROA$_{t-2}$, sale growth$_{t-1}$, cash$_{t-1}$, volatility$_{t-1}$, log(1 + CEO age)$_{t-1}$, female dummy, and CEO/chairman duality along with year fixed effects and industry fixed effects. Panel B reports estimates of the effects of winning an award on innovation after controlling for CEO overconfidence in the 2SLS IV model. The procedure of the two-stage regression is similar to Table 7. All continuous variables are winsorized at the 1% level. Variables are described in more detail in **Appendix A**. The standard errors are estimated by bootstrapping and are reported in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively.

## 6. The Effect of Winning an Award on Innovation and Institutional Ownership

The evidence from this study, thus far, suggests that superstar CEOs who win awards are better innovators in terms of both the quantity and the quality of their innovation. In this section, we examine whether the magnitude and significance of the positive effect of CEO awards on innovation differ across a measure of managerial long-term incentives: institutional ownership.

The innovation literature has also explored the relationship between effective monitoring of CEOs and innovation. In this study, we focus on institutional holdings as a proxy for a firm's level of effective monitoring. Edmans (2009), in his theoretical model, contends that blockholders have strong incentives to collect costly information about the fundamental value of the firm and, in turn, their trades help stock prices reflect the fundamental value of the firm rather than short-term earnings. Thus, he demonstrates that blockholders encourage managers to focus on the long-term value of the firm rather than its short-term value. Aghion et al. (2013) examine whether institutional ownership affects a firm's innovation decisions and show that there is a positive relationship between institutional holdings and innovation. Further, they propose two plausible hypotheses to explain the source of the positive effect of institutional holdings on innovation: managerial slack (institutional investors push lazy CEOs to innovate more) and career concerns (institutional investors monitor CEOs more effectively using better information and abilities). Using the relationship between institutional holdings and product market competition for managerial innovation incentives, they conclude that the positive effect of institutional ownership on innovation is stronger in more competitive markets, which suggests that product market competition and institutional holdings complement each other. In other words, institutional investors encourage CEOs to innovate more, not by forcing lazy CEOs to innovate, but by protecting them from bad luck that happens for purely stochastic reasons. Manso (2011), in his principal-agent theoretical model, also posits that timely feedback by the principal (e.g., blockholders) on performance motivates the agent (managers) to innovate. The existing research discussed above suggests that institutional ownership provides more job security to managers and relieves managerial short-termism.

Based on the literature discussed above, we expect the effect of winning a high-profile award on innovation to vary across firms with different levels of institutional ownership. However, it is not clear whether the positive effect of winning an award is stronger or weaker for firms with more effective monitoring by institutional investors, as this depends on whether winning an award and institutional ownership are substitutes or complements for managerial long-term incentives. If they are substitutes, the additional effect of winning an award should be smaller for CEOs who already have sufficient long-term incentives by high institutional ownership. If they are complements, the more relief from managerial short-termism there is, the more long-term incentives managers will have. In other words, the additional effect of winning an award should be larger because high institutional ownership boosts the impact of award-winning on the CEOs' long-term incentives.

We collect institutional ownership data from Thomson Reuters Ownership Database. Since the database provides quarterly institutional holdings, we use the institutional holdings for a quarter prior to the CEO awards. We partition the sample into two groups (low institutional ownership and high institutional ownership) at the median of institutional holdings. We rematch actual award-winners with predicted award-winners within each group. **Table 9** reports the matching estimates by high- and low-institutional ownership groups. For all of the matching algorithms (10-neighbor matching is not tabulated), the effects of awards on both a quantity and quality measure of innovation are significant during the four years following the award for both groups at the 10% level, except for the effect at year $t + 4$ for the high institutional ownership group. However, the effect of winning an award on innovation is significantly larger for the low institutional ownership group than it is for the high institutional ownership group at the 1% level (for single-nearest neighbor matching) during the four years following the award, indicating that winning an award and institutional ownership are a substitute for managerial long-term incentives. In other words, CEOs who are, *ex ante*, provided with long-term incentives by high institutional ownership will have a small additional impact of winning an award on innovation than CEOs in firms with low institutional ownership.

In sum, the evidence presented here is consistent with prior literature on the role of institutional investors on corporate decisions; institutional investors play an important role in motivating managers so that they do not make myopic decisions. Furthermore, the heterogeneous effect of winning a high-profile award on innovation across firms with different levels of institutional ownership suggests that institutional ownership and winning an award are substitutes for managerial long-term incentives: institutional ownership mitigates the effect of winning a high-profile award on innovation.

## 7. Summary and Conclusion

In this paper, we examine how a shift in CEO status as a result of winning a high-profile award affects a firm's innovation decisions. Two opposing views in the context of CEO power (greater job security) predict different consequences of winning such prestigious awards on a firm's innovation. The agency view predicts that CEOs who win awards (superstar CEOs) innovate less due to self-dealing behaviors and because they use their heightened power within the firms to take private benefits of control at the cost of the shareholders. In contrast, the managerial flexibility view suggests that superstar CEOs innovate more. A decline in the threat of job termination enables a superstar CEO to take on more long-term and innovative projects with less pressure on their short-term performance. In addition to the managerial flexibility hypothesis, the managerial overconfidence view

Table 9. Institutional ownership, CEO awards, and innovation.

| Outcomes | Low Institutional Ownership (N = 462) | | High Institutional Ownership (N = 307) | | Difference (Low-High) | |
|---|---|---|---|---|---|---|
| | Single Nearest Matching Estimate | Kernel Matching Estimate | Single Nearest Matching Estimate | Kernel Matching Estimate | Single Nearest | Kernel |
| $Patent_{t+1}$ | 0.0941*** | 0.1173*** | 0.0734*** | 0.0711*** | 0.0207*** | 0.0462*** |
| | (0.0134) | (0.0071) | (0.0213) | (0.0137) | (0.0170) | (0.0103) |
| $Patent_{t+2}$ | 0.1268*** | 0.1342*** | 0.0694*** | 0.0830*** | 0.0574*** | 0.0512*** |
| | (0.0141) | (0.0071) | (0.0287) | (0.0114) | (0.0212) | (0.0091) |
| $Patent_{t+3}$ | 0.1201*** | 0.1412*** | 0.1067*** | 0.0996*** | 0.0134*** | 0.0416*** |
| | (0.0233) | (0.0111) | (0.0306) | (0.0132) | (0.0265) | (0.0120) |
| $Patent_{t+4}$ | 0.1419*** | 0.1396*** | 0.1312*** | 0.1189*** | 0.0107*** | 0.0207*** |
| | (0.0166) | (0.0165) | (0.0275) | (0.0128) | (0.0216) | (0.0151) |
| $Citation_{t+1}$ | 0.1509*** | 0.1413*** | 0.1234** | 0.1165*** | 0.0275*** | 0.0248*** |
| | (0.0575) | (0.0223) | (0.0538) | (0.0321) | (0.0561) | (0.0267) |
| $Citation_{t+2}$ | 0.1501*** | 0.1380*** | 0.0942* | 0.1357*** | 0.0599*** | 0.0023 |
| | (0.0433) | (0.0227) | (0.0553) | (0.0279) | (0.0484) | (0.0249) |
| $Citation_{t+3}$ | 0.2009*** | 0.1358*** | 0.1302** | 0.1115*** | 0.0707*** | 0.0243*** |
| | (0.0457) | (0.0232) | (0.0582) | (0.0220) | (0.0511) | (0.0227) |
| $Citation_{t+4}$ | 0.1598*** | 0.1154*** | 0.0596 | 0.0906*** | 0.1002*** | 0.0248*** |
| | (0.0408) | (0.0207) | (0.0485) | (0.0253) | (0.0440) | (0.0227) |

This table presents cross-sectional variation in the effects of prestigious awards on innovation by institutional holdings. We obtain quarterly institutional holdings from Thomson Reuters Ownership Data and aggregate them into annual holdings. Based on the median of the institutional holdings across groups, we partition the sample into two groups: groups with high institutional holdings and groups with low institutional holdings. We then rematch actual award-winners with benchmark CEOs within each category. Predicted winners (P) are selected by a single nearest neighbor, multiple nearest neighbor (not reported), and a kernel propensity score matching procedure (with Gaussian kernel function). We describe more details about matching procedure in **Appendix B**. The last column represents t-statistics of the differences in treatment effects between groups with high and low institutional holdings. The standard errors are estimated by bootstrapping and are reported in parentheses. ***, **, and * represent significance at 1%, 5%, and 10% levels, respectively.

(Hirshleifer et al., 2012), also predicts a positive effect of winning a prestigious award on innovation if award-wining CEOs become overconfident after the award.

Using a propensity score matching as the main identification strategy, I find that CEOs who win high-profile awards, on average, innovate more, in terms of the number of patents and citations per patent, than their benchmarks. The finding that superstar CEOs are better innovators is robust using a different treatment effect model assumption (temporary shift model), broader sample periods, and a different estimation technique (a two-stage least squares instrumental variable design).

We then explore a potential source for the positive award effect on innovation. We determine that there is a clear shift in CEO power after CEOs win an award and that they tend to extract rents and are less likely to be fired by the boards even when they underperform. However, we fail to find evidence that winning a prestigious award drives CEOs to become more overconfident. We also confirm that the positive effects of winning an award on innovation remain similar, even after controlling for the effect of CEO overconfidence.

Lastly, we explore whether the effects of awards on innovation are heterogeneous by institutional ownership. We find that the positive award-winning effect on innovation is weaker for firms with high institutional ownership, concluding that winning a prestigious award and institutional ownership are substitutes for managerial incentives for long-term growth.

The results given in this paper is consistent with the managerial flexibility view that a CEO who achieves greater job security (and, in turn, reduced managerial myopia) as a result of winning a high-profile award promotes more innovation[17]. This study contributes to the extant literature by using a unique and more recent measure of CEO entrenchment (i.e. prestigious CEO awards) and reliable long-term performance measures (i.e. innovation).

The evidence here illuminates the bright side of managerial entrenchment and superstar status—seeking long-term growth and success by engaging in more innovative projects—in contrast to the findings in previous literature, and it helps resolve the current puzzle of why many firms have actively chosen to weaken shareholder rights and given excessive power to their CEOs over their boards.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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[17]The evidence in this paper can be reconciled with Atanassov's (2013) study in that the shock used in this study is an example of an internal governance mechanism that affects CEO behavior through the board of directors, while hostile takeovers are an example of an external governance mechanism. In addition, winning prestigious CEO awards causes greater investor attention (and, in turn, increases monitoring), which incentivizes award-winning CEOs to maximize the long-term value of their firms. In contrast, enacting anti-takeover state-level laws might be seen as "a windfall" by investors so they do not pay much attention to monitor the CEOs' behaviors.

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## Appendix A

| Variables | Description |
| --- | --- |
| First-award dummy (permanent model) | Indicator variable: 1 for all the years after a CEO wins a first award at *t* and 0 for all non-winners |
| First-award dummy (temporary model) | Indicator variable: 1 if a CEO wins a first award at *t* and 0 otherwise |
| Multiple-award dummy | Indicator variable: 1 if a CEO wins any award at *t* and 0 otherwise |
| $Patent_t$ | Number of patents for each firm at year *t*, scaled by the total number of patents for all firms at year *t* |
| $Citation/patent_t$ | Number of citations per patent for each firm at year t, scaled by the citation measure by the average number of citations per patent at year *t* |
| Sales | Firm sales are in logarithmic |
| Stock return | Total compound returns prior to the award month adjusted by Carhart's four-factors ($R_m$-$R_f$, SMB, HML, and UMD) for each year which are collected from the French's online website |
| R&D expense | Reported R&D spending scaled by total assets |
| Leverage | Total long-term debt over total assets |
| Profitability | Earnings before interest depreciation taxes and amortization (EBITDA) divided by total assets |
| Tangibility | Net property, plant, and equipment over total assets |
| Herfindahl index | Sum of squared shares of the sales for all companies within the same 4 digit SIC level |
| Firm age | 1) Number of years since the firm's initial public offering or 2) number of years elapsed since a firm first appears in the CRSP database (if the initial public offering date is not available) |
| Market capitalization | Price multiplied by shares outstanding measured at the end of the last fiscal year prior to the award month |
| Book-to-market | Stockholders' equity over market equity |
| Tobin's Q | Total assets plus market equity minus book equity, divided by total assets |
| Asset growth | (Total asset at $t$ – total asset at $t - 1$)/total asset at $t - 1$ |
| Firm risk | Standard deviation of most recent 3 years of monthly stock returns |
| G-index | Governance index which is constructed by Gompers, Ishii, and Metrick (2003) |
| CEO delta | Sensitivity of a CEO's stock and option value ($ thousands) to a 1% change in stock price |
| CEO vega | Sensitivity of a CEO's stock and option value ($ thousands) to a 1% change in stock return volatility |
| CEO total compensation | Sum of salary, bonus, other annual compensation, restricted stock grants, LTIP payouts, options grants, and all other total compensation |
| CEO cash compensation | Salary plus bonus, presented in $K |
| CEO age | Measured in years as reported by Execucomp database |
| CEO tenure | Number of years that a given CEO has held the position |
| CEO/Chairman duality | Indicator variable: 1 if a CEO is also a chairman of a board and 0 otherwise |

**Continued**

| | |
|---|---|
| Female | Indicator variable: 1 if a CEO is female and 0 for male |
| CEO turnover | Categorical variable: 1 for exogenous turnover (scheduled retirement, death, etc.), 2 for unclassified turnover, 3 for forced turnover (clearly stated in the Factiva that a CEO was fired, forced to leave, or left following a policy disagreement), and 0 for no turnover events. |
| Poor performance | Indicator variable: 1 if a firm belongs to the bottom 25% group based on industry-adjusted ROA and 0 otherwise |

# Appendix B

## B.1. Main Identification Strategy: Propensity Score Matching

In this study, we examine whether a shift in CEO status as a result of winning a high-profile award affects innovation decisions. In the analytical framework, the treatment effect (effect of winning an award) is the difference between potential outcomes (innovation outputs) with and without treatment for group *i*:

$$\text{treatment effect} = Y_i^1 - Y_i^0$$

where $Y$ represents potential outcomes and 0 and 1 denotes non-treatment and treatment group respectively.

Each group is identified as a combination of a CEO and a firm[18]. The goal of this study is to examine the average treatment effect on the treated groups (ATT):

$$ATT = E\left(Y_1 - Y_0 \middle| T = 1\right).$$

where $T = 1$ refers to the treatment.

In our study, we compare post-award innovation outputs of an award winner's firm $\left(E\left(Y_1\right)\middle|T=1\right)$ to the counterfactual firm (i.e., the same firm had the CEO not received the award) $\left(E\left(Y_0\right)\middle|T=1\right)$. However, because the counterfactual firm's innovation outputs are not observable, appropriate benchmark groups corresponding to each treatment group should be selected by an empirical specification. Thus, we employ a propensity score matching technique (Rosenbaum and Rubin, 1983) to pick benchmark groups similar to treatment groups. A propensity score matching technique is preferred over parametric regressions for the following reasons: A propensity score matching procedure, which is a non-parametric technique, does not need to impose a functional form on outcomes which would be required in a multivariate regression framework. In addition, explanatory variables in a regression are usually correlated with an error term, resulting in an inconsistent and biased estimate on treatment effects.

The propensity score matching procedure has two stages. In the first stage, a propensity score for each group is estimated by running a logit (or probit) regression where the dependent variable is a treatment dummy (whether a CEO wins an

[18]For example, if a firm has three CEOs in its history, we identify the three CEOs as separate groups since each CEO has heterogeneous innovation decisions, given his/her firm's characteristics and operational environment. Likewise, if a CEO has served for three firms in his/her career, that CEO belongs to three different groups since he or she might make different innovation decisions, given that each firm has different characteristics and a different operational environment.

award or not at year *t*) and independent variables are matching variables by which the treatment and control groups are matched. In the second stage, a treatment effect (award-winning effect) on outcome variables (innovation outputs) is estimated after treatment groups are matched with control groups based on the propensity scores.

### B.2. Matching Schemes

A variety of algorithms in the propensity score matching technique have been developed in the econometric literature in order to choose the best similar control groups based on propensity scores. Among these algorithms, we choose a single nearest neighbor matching, *N*-neighbor matching, and a kernel matching algorithm for our analysis. The single nearest neighbor matching selects a benchmark whose propensity score is the closest to the treatment group. The *N*-neighbor matching chooses multiple benchmark groups after it ranks all control groups based on the distance of their propensity scores from that of the treatment group. Thus, it provides multiple benchmark groups per treatment group. The kernel matching is a non-parametric matching procedure that provides the weighted average of the counterfactual outcomes of all control groups based on the distance of propensity scores between treatment and control groups. Thus, the kernel matching algorithm uses more information from all control groups than a single or an *N*-neighbor matching method and, as a result, it reduces the variance of estimates. However, the single nearest neighbor matching algorithm and the *N*-neighbor matching algorithm have a lower bias than the kernel matching algorithm since kernel matching might use many bad matches. Therefore, in this paper, we employ all three matching algorithms (a single nearest neighbor, *N*-nearest neighbor, and a kernel matching) to estimate the effects of awards on post innovation activities.