Inventor CEOs and Corporate Innovation

Abstract

One in four U.S. high-tech firms are led by CEOs with hands-on innovation experience as inventors. We show that these “Inventor CEOs” stimulate higher quality firm-level innovation, especially when they have a personal history of high-impact patents. A CEO’s technology-class specific inventor experience also predicts the technology classes in which a firm has its greatest innovation success. Utilizing exogenous CEO turnovers and R&D tax credit shocks to address the endogenous matching of firms with CEOs suggests these effects are causal. One channel through which Inventor CEOs stimulate higher quality innovation is through a superior ability to evaluate innovation-intensive investment opportunities.

JEL Classification: G32, G34, J24, l26, O31, O32

Key words: Inventor CEOs, Innovation, R&D, Human Capital

“Innovation has nothing to do with how many R&D dollars you have. When Apple came up with the Mac, IBM was spending at least 100 times more on R&D. It’s not about money. It’s about the people you have, how you’re led, and how much you get it.” - Steve Jobs, former CEO, Apple Inc.

1 Introduction

A CEO’s personal “style” can have a significant impact on corporate policies and performance (Bertrand and Schoar (2003)). One important, yet unexplored aspect of a CEO’s personal background that may influence their “style”, is the extent to which they possess hands-on innovation experience as an inventor. In this study, we examine whether CEOs with such first-hand experience (Inventor CEOs) impact upon the nature of their firm’s innovation activities.

To understand why a CEO’s first-hand exposure to technical innovation should matter, we drawn upon the learning-by-doing literature. This literature contends that hands-on experience is a critical channel through which individuals acquire and refine specialized skills (see Arrow (1962), Alchian (1963) and Irwin and Klenow (1994)). In our context, we hypothesize that a CEO’s inventor experience endows them with a unique ability to evaluate, select and execute innovative investment projects for the firms they lead.

Hands-on experience has also been shown to explain the quality of investment decisions in a somewhat related context. Cai, Sevilir and Tian (2015) show that venture capitalists with experience as entrepreneurs have a positive impact on the performance of their VC funds. Their argument follows a similar logic to our hypothesis: A VCs entrepreneurial experience provides them with an information advantage in evaluating start-up firms. An anecdote provided by Sanjay Mehrota, an Inventor-CEO with more than 70 patents registered in his name, helps to illustrate how our hypothesis applies in practise. In describing how his inventor experience has enhanced his executive functions he notes: “*It’s helped me a great deal in understanding the capabilities of our technology, and in assessing the complexities of the challenges ahead. That makes a big difference* *in determining strategic plans and in managing execution. It becomes easier to focus attention on the right issues*".[1]

To determine the effect of a CEO's inventor experience on their firm's innovation, we assemble a novel hand collected dataset that tracks the patenting history of CEOs in U.S. high technology firms over a 17-year period prior to the beginning of our sample period. CEOs that are awarded at least one patent in their own name are designated as "Inventor CEOs". We document the presence of Inventor CEOs in 18.7% of all firm-years in our sample. We choose to limit our focus to the U.S. high-tech sector for two reasons. First, this sector accounted for virtually the entire U.S. R&D boom, especially young firms in these industries (Brown, Fazzari and Petersen (2009)). Second, Hambrick, Black and Fredrickson (1992) show that, unsurprisingly, top executives with technical backgrounds are concentrated in high-technology industries, where such experience is most relevant. Thus, we are not likely to observe sufficient variations in Inventor and Non-inventor CEO led firms outside of these industries.

We find that firms led by Inventor CEOs are associated with a greater volume of registered patents, more highly cited patents and greater innovation efficiency (patent output relative to R&D). We also show that Inventor CEO-led firms are more likely to spur ground-breaking or disruptive innovations, shown by their greater propensity to produce patents that receive the highest number of citations in any given industry-year.

The positive correlation between Inventor CEOs and innovation needs to be interpreted with caution. Inventor CEOs and/or the firms they lead could be self-selected based on unobservable characteristics that also relate to more successful innovation. We address this concern in two ways. First, we analyze variations among only the Inventor CEO sample. If a CEO's first-hand inventor experience does indeed drive the above

[1] The academic profession provides yet another anecdote regarding why hands-on "doing" experience matters when evaluating innovation. The task of evaluating a paper's scholarly contribution (or innovation) is exclusively entrusted to those with proven hands-on experience "doing" innovative research (journal editors and referees). The implicit assumption behind this practise is that these individuals can identify innovative research precisely because they have done it themselves.

positive correlation, then this effect should be more observable for CEOs with stronger inventor credentials. Our results show that Inventor CEOs with a history of high-impact patents are more strongly associated with successful firm-level innovation.

Second, we attempt to tie an Inventor CEO's specific technology-class experience more closely with the specific innovation outputs of their firm. In particular, if an Inventor CEO's advantage lies in being able to more effectively evaluate innovation intensive investment opportunities, then we should expect them to exploit this advantage by focusing on investments in technology-classes related to their own hands-on experience. To test this conjecture, we categorize each Inventor CEO's individual patenting experience before becoming the CEO at their firm into discrete technology classes as defined by the U.S. Patent and Trademark Office. We then test whether an Inventor CEO's prior technology-class expertise affects the technology-class distribution of patents produced by their firm. We find that technology classes in which an Inventor CEO possesses first-hand experience increase their percentage share of firm-level patents by around 8 percentage points following the appointment of an Inventor CEO. We also find that an Inventor CEO's experience in a particular technology class significantly increases the likelihood that a firm achieves technological breakthroughs (or radical innovation) in that specific technology class.

Our analysis of variations among the Inventor CEO sample also uncovers a novel fact. Almost half of all Inventor CEOs continue to register patents in their own name *during* their tenure as CEO.[2] We designate CEOs that are named inventors on their firms' patents during their tenure, as "Innovation Active CEOs".[3] By construction, an

[2] Reconciling a CEO's everyday activities, with being an active inventor can seem somewhat perplexing. A Silicon Valley patent lawyer clarifies how this works in practise. "…a lot of innovation is going to involve user-level features. That's what CEOs think about in their day job. Those innovations don't require expensive labs. They can be sketched out on a white board. In fact, you can develop them sufficiently in an hour or two to support a patent application." see https://www.forbes.com/sites/georgeanders/2012/07/16/geniuses-or-dabblers/#7fda011b231a

[3] An example of Innovation Active CEO is Netflix's Reed Hastings. One of Netflix's important yet simple innovations was the propeitary design of a DVD envelope that allowed safe and cost effcitive shiping. Patent records show Hastings was a co-inventor of the envelop design during his tenure as CEO.

Innovation Active CEO's experience is aligned with their current firm's innovation activities. In such cases, their inventor expertise may be more valuable to the firm. Further, since Innovation Active CEOs have hands-on *involvement* in their firm's innovation, they are likely to be more connected to grass roots innovation efforts within their organizations. Such an innovation-centric leadership style has also been shown to spur superior innovation within a firm.[4] Our results show that the presence of Innovation Active CEOs is more strongly associated with a firm's patent impact and patent volume. These results hold even when excluding firm patents on which the CEO is a named inventor. This suggests that, in additional to hands-on innovation experience, a CEOs *first-hand involvement* in their firm's innovation has important spill-over benefits for firm-wide innovation.

The correlation we establish between Inventor CEOs and firm-level corporate innovation activities can be interpreted in at least two ways. First, innovative firms or firms with higher innovation potential may optimally hire Inventor CEOs because they have the relevant skillset to achieve the firm's objectives (i.e. endogenous matching). For example, a firm may wish to innovate in a promising new technology class, and thus hires an Inventor CEO with relevant experience in this class. The second interpretation is that Inventor CEOs may in fact be imposing their particular "style" on the firm and it is this that leads to both a change in technology class focus and higher quality innovation outcomes. It is important to note that both of these interpretations imply the existence of a unique skillset for Inventor CEOs in stimulating innovation. Thus, we believe the correlations we document are in themselves an important contribution of our paper. Nevertheless, it is only the second interpretation that confirms that Inventor CEOs actively *cause* firms to become better at innovation, since under the endogenous matching interpretation it remains unclear whether an Inventor CEO actually delivers

[4] Studies in the management literature suggest that CEOs with a transformational (as opposed to a transactional) leadership style that intellectually engage with their employees, create a corporate culture more conducive to innovation (see Bass and Avolio (1993, 1994), Jung, Chow and Wu (2003))

on the strategy they are hired to execute. In other words, the primary driver of innovation outcomes may be the firm's optimal strategy, rather than the CEO's role in executing the strategy.

To identify the causal effect of Inventor CEOs, we study exogenous Inventor CEO departures and show that firms switching from Inventor to Non-inventor CEOs, experience an economically sizable and statistically significant reduction in corporate innovation output and impact relative to firms experience an exogenous switch from a non-inventor to a non-inventor CEO. In a smaller sample of cases, we are also able to study the effects of these same exogenous departures on the distribution of a firm's patents across technology classes. We find that the departure of an Inventor CEO significantly reduces the likelihood that a firm produces radical innovation in the technology class where outgoing CEO's experience lies.

One potential criticism with studying exogenous CEO turnovers is that the choice of the Inventor CEO's successor may not be exogenous. In particular, firms replacing inventors with non-inventors may do so because it is no longer optimal to have an Inventor CEO. However, since exogenous CEO departures should occur randomly over time, we argue that the CEO succession choice should not, on average, be systemically related to a firm's time-varying innovation potential and thus the decision not to hire an Inventor CEO.[5]

To further address the concern that firm-types hiring inventor CEOs are inherently more innovative, we use a propensity score matched sample of firms to ensure that Inventor-CEO led firms are compared with appropriate counterfactuals. We continue to find a strong and economically meaningful positive effect of Inventor CEOs on corporate

[5] Our preliminary evidence suggests that the decision not to continue hiring inventor CEOs is likely to be related to the lack of supply of such CEOs in the labour market, which is exogenous to an individual firm's innovation activity. For instance, we find Inventor CEO's receive significantly higher total compensation, reflecting their short supply in the labor market.

innovation using counterfactuals from the exact same industry and similar propensity scores constructed using an extensive set of covariates.

We also attempt to rule out several alternative explanations for our story. There are three such candidate explanations which are particularly compelling. First, it is plausible that many Inventor CEOs are also founder CEOs and it is in fact a founder effect that is driving our results. After including a founder CEO dummy in our empirical specifications, we continue to find very similar coefficients on the Inventor CEO coefficient. In an unreported test, we also exclude all founder CEO firms from our sample and continue to find a positive and significant coefficient on Inventor CEOs. Second, the Inventor CEO variable may just be picking up a CEO's technical expertise, and not necessarily their inventor experience per se. To deal with this, we control for a CEO's technical education (having an undergraduate degree or a Ph.D. in Science, Technology, Engineering, and Mathematics) and find our results continue to hold. Third, Inventor CEOs may just be a subset of corporate executives with specialist management skills suited to high-tech firms (rather than inventor experience). We use the General Ability Index from Custodio, Ferreira and Matos (2017) to account for the nature of a CEO's life-time executive experience and continue to find that Inventor CEOs have a positive incremental effect on corporate innovation outcomes.

The results also survive the use of firm-fixed effects (for our time varying Inventor CEO measures) and the inclusion of a host of other control variables that account for other potentially confounding explanations. These include CEO overconfidence (Hirshleifer, Low and Teoh (2012)), CEO incentives (e.g. CEOs' ownership, equity based pay, CEO Delta, CEO Vega), and internal and external corporate governance (e.g. board size, board independence, and institutional holdings). Our results are also robust to alternative econometric specifications.

We next investigate the firm-value implications of Inventor-CEOs. The superior innovation performance of Inventor CEO firms may also result from an over-investment in innovation. Here, while the CEO maybe technically adept, he/she may lack the ability to evaluate the commercial potential of their innovation and thus harm outside shareholder value. Further, Innovation Active CEOs may be distracted from their core executive duties, which could be also detrimental to firm value. Using a simple OLS regression we document a positive correlation between Inventor CEO-run firms and firm value. We find that this positive correlation is even stronger for Innovation Active CEOs. To make stronger causal claims about this result, we employ the same set of exogenous Inventor CEO departures used above, and conduct a difference-in-difference analysis examining the changes in valuations around such departures. We find that a change form an Inventor to a Non-inventor CEO leads to a statistically significant reduction in firm value, relative to firms that transition from non-inventor to non-inventor CEOs.

Finally, we investigate the economic channels through which Inventors CEOs promote higher quality innovation at their firms. We focus on providing more direct evidence on whether Inventor CEOs possess a superior ability to select and evaluate innovative investment opportunities. To do this we study one of the largest (and most observable) investment decisions made by firms, corporate acquisitions. The existence of superior Inventor CEO investment selection skill, generates several deal-level predictions in the M&A market.

Bidders in the M&A market can face a winner's curse problem (Thaler (1988), Barberis and Thaler, (2003), Baker, Ruback, and Wurgler, (2007)). This problem is most severe when the target's valuation is uncertain and when some bidders are more informed than others. If Inventor CEOs are more informed about the true value of certain types of target firms, then fearing the winners curse, competing bidders would in equilibrium, stay away from these targets. Conversely, Inventor CEOs should optimally target firms which allow them to exploit this information advantage. The lack of bidder competition for such firms should also generate greater value for the acquirer. We find evidence consistent with these arguments. Inventor CEO-run firms are more likely to acquire private high-tech firms and firms with larger patent portfolios (i.e. firms that are harder to value). We also show that when Inventor CEOs acquire such targets, their firms attract significantly higher acquirer announcements returns relative to acquirers that are led by non-inventor CEOs. These effects are strongest for Innovation Active CEOs and high-impact Inventor CEOs.

For many high-tech firms, the success of their investment decisions is ultimately determined by the traction their products (the investment outputs) achieve with customers. Thus, we also study the stock price reaction to new product announcements made by Inventor CEO-led firms. We show that the stock market reacts more positively to new product announcements made by Inventor CEOs. This incremental value creation suggests that the greater volume and impact of patenting produced by firms led by inventor CEOs reflects the protection of valuable proprietary assets that translate into superior products and thus increase value for shareholders. It also supports the notion that Inventor CEOs possess superior skills in choosing to invest in products whose innovativeness appears to be recognised with higher market returns.

The superior ability of Inventor CEOs to select and evaluate investment projects may not be the only channel through which their inventor experience matters. Our results may also be explained through other channels which we have not been able to capture. For example, Inventor CEOs may create an innovation-centric corporate culture which cannot be easily measured or observed. Inventor CEOs may also naturally possess personal traits that pre-dispose them to innovative activity. For example, they may be more 'open to new experiences' and thus willing to take more risks or have a higher tolerance for failure. Acemoglu, Akcigit and Celik (2014) suggest that such personal characteristics can have a significant impact on corporate innovation.

Our paper makes several contributions to the literature. Firstly, we contribute to the corporate innovation literature, by uncovering a new CEO characteristic which can positively affect corporate innovation. This builds on recent work such as Custodio et al. (2017) and Sunder et al. (2016) who show that generalist CEOs and sensation seeking CEOs, positively affect corporate innovation. Our finding that Inventor CEOs appear to be more capable of facilitating innovation in their firms, adds to the understanding of why some firms are more innovative than others (Acemoglu et al. (2014)).

More broadly, our findings complement existing studies on how heterogeneity in CEO characteristics influences firm outcomes (Bertrand and Schoar (2003)). These studies suggest that CEOs having particular career experiences can affect firm-level policies. Daellenbach et al. (1999) find that higher R&D spending is associated with top management teams and CEOs' having technical work experience. Custodio and Metzger (2013, 2014) show that a CEO's specific expertise affects acquisition returns as well as corporate policies and firm value. Dittmar and Duchin (2015) show that CEOs with distress experience use less debt, save more cash and invest less than other CEOs. Bernile et al. (2017) show a non-monotonic relation between CEO's early-life exposure to fatal disasters and corporate risk taking.

2 Data

2.1 Sample Selection

Our sample comprises high-tech publicly traded firms in the S&P 1500 from 1992-2008 for which we have reliable data on CEO characteristics from ExecuComp. We focus on high-tech firms because a significant majority of innovation takes place in the high-tech industries (Brown et al. (2009)) and this is where an Inventor CEO's experience is likely to be most directly relevant. We define a firm as being in a high-tech industry based on the classification in Loughran and Ritter (2004).[6] We exclude regulated financial firms and utilities in our sample as they have negligible R&D investments.

[6] Specifically, it includes industries such as computer hardware (SIC codes 3571, 3572, 3575, 3577, 3578); communications equipment (3661, 3663, 3669); electronics (3671, 3672, 3674, 3675, 3677, 3678, 3679); navigation equipment (3812); measuring and controlling devices (3823, 3825, 3826, 3827, 3829); medical instruments (3841, 3845); telephone equipment (4812, 4813); communications services (4899); and software (7371, 7372, 7373, 7374, 7375, 7378, 7379).

For a firm to be included in our sample, we first require that it is present in the Kogan, Papanikolaou, Seru amd Stoffman (2016) (henceforth KPSS) Patent dataset. We use the KPSS (2016) patent data instead of the NBER patent data because it has six additional years of data coverage. The KPSS patent dataset provides data for all patents that are granted by U.S. Patent and Trademark Office (USPTO) over 1926-2010. The dataset provides information on the number of patents and the number of citations received by each patent filed with the USPTO. We follow the innovation literature and date the patents by the year of their application (Hall, Grilches and Hausman (1986)). This also ensures that anomalies caused by the time lag between the applications and the grant date of a patent are taken care of. We restrict the sample to patents applications up to 2008 considering that patents applied for after 2008 may not appear in the dataset until 2010 (the final year of data) because of the time lag in granting patents. We use PERMNO of the assignee of KPSS patent data to merge the patent data with Compustat and CRSP. In the baseline OLS based specifications, we assign zero to firm-years observations without any patenting activity.

2.2 Classifying Inventor CEOs

A major challenge in determining the effect of CEO's hands on innovation experience on corporate innovation is the construction an accurate dataset of Inventor CEOs. We use the US Patent Inventor Database from Li et al. (2014) (henceforth PID) to identify CEOs in our panel who have been awarded at least one patent. We describe the matching of the PID dataset to Execucomp in detail in the Appendix.

When we find that a CEOs in our panel has been awarded at least one patent in their own name, from that point forward, we designate them as an Inventor CEO. To further explore the effect of Inventor CEO heterogeneity we also construct several other Inventor CEO measures that reflect their nature of their inventor experience. We first distinguish Inventor CEOs with a particularly successful inventor track record. To do this, we collect data on how impactful their patents have been, as measured by their forward-looking citation data. We designate an Inventor CEO as having *High-Impact Innovation experience* if they are an patentee on more than 2 patents that accumulates an above median number of citations in a patent-class-year. In our sample, this median value is equal to 2. Conversely an Inventor CEO with *Low-Impact Innovation experience* will have a below-median number of patent class-year adjusted citations.

Our analysis of CEO patenting behaviour also reveals a somewhat surprising fact. Half of the Inventor CEOs in our sample, continue to be an active inventor during their tenure as CEO. We designate such CEOs as “Innovation Active”. In all cases in our sample, Innovation Active CEOs are named inventors (or co-inventors) on patents registered to their current firm. This implies that an Innovation Active CEOs patenting experience is directly relevant to their firm’s innovation activities. To account for the fact that a CEO can be involved in patent applications well before they are registered, we designate a CEO to be Innovation active if they have at least one patent issued in their own name around 2 years of focal firm year while they are CEO.

2.3 Measuring Innovation at the Firm-level

Since we relate a CEO’s Inventor experience to their firm’s innovation outcomes, we construct several measures to capture firm-level innovation. Following the extant literature (e.g., Hirshleifer et al. (2012)), we use number of patents applied for (and subsequently granted) as a proxy for the quantity of innovation. To distinguish major technological breakthroughs from incremental technological improvements, we also use the number of citations received by these patents to measure quality of innovation.[7]

[7] Studies employing these two variables to measure innovation performance include among others Hirshleifer et al. (2012), Seru (2014), Tian and Wang (2014), He and Tian (2013), Hsu, Tian and Xu (2014) Fang, Tian and Tice (2014), Chemannur and Tian (2013), Bereskin and Hsu (2013), Kang, Liu, Low and Zhang (2014), Atanassov (2013)

We also construct a number of additional variables that capture the efficiency of innovation activities. Specifically, we construct log of citations scaled by Patents (average citations) as this is expected to measure the average quality of the innovation. Additionally, to distinguish 'disruptive' innovation form mere technological improvement, we also construct a variable labelled, "Radical innovation", a dummy variable equals 1 if the patent has accumulated the maximum number of citations among all patents applied in a given year and in a given industry. A similar variable is used in Acemoglu et al. (2014) to distinguish incremental innovation from radical or disruptive innovation. Specifically, they measure the fraction the patents of a company that are at the 99th percentile of the overall citations distribution relative to those that are at the median number of citations.

2.4 Control Variables

In the baseline specifications, following the innovation literature, we control for standard covariates that are important determinants of corporate innovation activities. Our firm-level controls are Firm size defined as the natural log of book value of total assets of the firm.[8] Sufficient investment into innovation inputs (R&D expenditure) is a necessary but not sufficient condition for innovation success. Since it is plausible that inventor CEOs could invest more in R&D to achieve above-average innovation success, we control for R&D scaled by assets to shed light on the efficiency aspect of innovation.

It is important to distinguish any potential Inventor CEO effects from firm age effects. Thus, we control for firm age in all our specifications since firms' life cycle may affect corporate innovation as well as the propensity to hire an Inventor CEO. We also control for other strategic investments such as capital expenditure scaled by assets. Since market value is highly correlated with the number of citations of patents, we also control for Log (Tobin's Q). The capital structure of R&D intensive firms customarily exhibits

[8] Chemmanur and Tian (2013) and Sapra et al. (2014), among others, use natural log of assets to measure firm size. Hirshleifer et al. (2012) and Kang et al. (2014), among others, use natural log of sales to measure firm size. Our results are robust using alternative measurements of firm size.

considerably less leverage than other firms (Hall (2002)). To account for differences in financial risk between innovative and non-innovative firms, we control for a firms' book leverage in our baseline specifications.

One could argue that CEO tenure could also potentially impact innovation, since firm specific CEO experience might lead to more efficient innovation, leading us to find a spurious correlation between Inventor CEOs and corporate innovation. We, therefore, control for CEO tenure in our baseline regressions. One might also argue that differences in CEO specific human capital may explain the Inventor CEO effect. As such, we control for CEO specific human capital using proxies used in the literature. Specifically, we follow Malmendier and Tate (2008), Galasso and Simcoe (2011), to identify CEOs with an MBA[9] or technical education. To control for CEOs' expertise in the fields relevant for innovation, we follow Sunder et al. (2016) and create a separate indicator for CEOs who hold PhDs in STEM (Science, Technology, Engineering, and Mathematics).

We also control for an Inventor CEOs founder status. Any Inventor CEO effects may be those generated by an Inventor-founder (Lee, Kim and Bae (2016)). Since no major dataset has compiled systematic data on founder-CEOs, we hand-collect all relevant information on founders of all the firms in the sample. Specifically, we collect the data related to names and number of founders of each firm, founding year, etc., from several sources including 10-K filings of the firms with the SEC available in Electronic Data-Gathering, Analysis, and Retrieval (EDGAR), the Funding Universe website, company websites, and other Internet resources including Wikipedia, Forbes pages, Bloomberg's Business Week website, among others. 'Founder-Dummy' in a given year is a dummy variable that equals one if any sources explicitly mention that the current CEO is one of the original founders of the firm or was a main executive at the time the company was founded (see, Adams et al. (2009) and Fahlenbrach (2009)).

[9] We also consider CEOs' acquiring Finance Education following Sunder et al. (2016) defined as an indicator equal to one if CEO received a degree in accounting, finance, business (including MBA), or economics or zero otherwise. We get similar results.

We consider the possibility that the Inventor CEO proxy is picking up the difference between generalist and specialist CEOs. Custodio et al. (2017) construct a General Ability Index (GAI) that measures the extent to which an executive's life-time experience is specialised. We use this index to control for the confounding effect of industry expertise on our results.

In robustness tests, we also control for other covariates for which the coverage for our sample firms is far from complete. These are CEO age (Acemoglu et al. (2014)), CEO Ownership (Kim and Lu (2011)), CEOs extrinsic incentives such as log (1+Delta) and log (1+Vega) (Sunder et al. (2016), Benabou and Tirole (2003)), CEO overconfidence (Hirshleifer et al. (2012), Galasso and Simcoe (2011)), We show that our findings are not driven by these factors.

Later in the analysis, we use natural log of Tobin's Q, log (Tobin's Q) to measure the market valuation of the firms. Tobin's Q is estimated as firm's market value to the book value where market value is calculated as the book value of assets minus the book value of equity plus the market value of equity.

The majority of our financial data is from Compustat's fundamentals annual data and ExecuComp. CEO-specific data are collected from ExecuComp and Risk Metrics. The final KPSS Patent-Compustat-CRSP-ExecuComp-Inventor CEOs merged file leaves us with 4621 firm-year observations for 543 unique high-tech firms.

2.5 Summary Statistics

We report the distribution of Inventor CEOs by year (Panel A) and by Fama-French Industry (12) group (Panel B) in Table 1. We identify 150 unique Inventor CEOs in 134 unique firms. The percentage of Inventor CEOs ranges from 13.5% in 1993 to 23.2% in 2005. Many of the Inventor CEOs are in the Medical Equipment industry group followed by Electronic Equipment industry group. In panel C of Table 1, we report the cumulative number of patents Inventor CEOs have been granted as of 2008. A total of

48 Inventor CEOs have been awarded a single patent grant, 19 have been awarded 2, while the rest have been awarded more than 2 patents. We provide a list of Inventor CEOs with more than 50 patent grants in Panel D of Table 1. The maximum number of patents that a CEO has been awarded as a patentee in our sample is 222 by Steve Jobs of Apple Inc.

We provide descriptive statistics for the major variable used in this study in Table 2. We classify the sample based on the Inventor CEOs variable, our main variable of interest, and report the means, medians and standard deviations for selected variables. We also compare the sample means and medians between the groups (Inventor CEOs and Non-Inventor CEOs) and indicate the statistical significance by conducting t-tests and Wilcoxon-Mann-Whitney tests. We find that a firm with an Inventor CEOs, on average, has 11.34 (25%) more patents and 112.56 (15.78%) more citations counts per firm-year observations compared to those of a firm run by Non-Inventor CEOs. Importantly, average citations per patent are very high for Inventor CEO run firms compared to those of non-Inventor CEOs run firms (1.59 compared to 1.184) and statistically highly significant at 1% level. Inventor CEOs, on average, have more strategic investments. Specifically, Inventor CEOs run firms, on average, spend 1.56 % more in R&D/assets compared to that of non-Inventor CEOs run firm and given the sample mean of 8.72%, this translates to approximately 14% more inputs to innovation. This suggests that Inventor CEOs provide the necessary access to resources to spur innovation. However, to ensure that this incremental spending on R&D is not driving our results, we control for R&D in all our specifications of innovations. R&D is only an input to the innovation process and Inventor CEOs may overspend on R&D, presumably, because of their natural inclination towards such projects.

In relation to the remaining control variables, Inventor CEO-run firms are, on average, younger in age, use lower level of leverage and have a higher market value. In terms of CEO characteristics, Inventor CEOs have, on average, longer tenure and higher stock ownership. We do not find any statistically significant differences in CEO age and CEO equity-based pay for both the groups. Though there is statistically significant difference in extrinsic incentives based on the Delta measure, the median difference using Vega based measure is not statistically significant.

3 Baseline results

3.1 The effect of Inventor CEOs on firm level innovation.

To examine the effect of Inventor CEOs on corporate innovation, we estimate the following empirical baseline OLS regressions:

$$Innovation_{i,t+n} = \alpha + \beta Inventor - CEO_{i,t} + \gamma Z_{i,t} + Industry_j + Year_t + \varepsilon_{i,t} \quad (1)$$

Where i indexes firm and t indexes time and n indexes periods (1,2 years). Innovation measure includes Patents $_{i,t+n}$, Citations $_{i,t+n}$, Avg Citations $_{i,t+n}$, defined as log (1+# of patents), log (1+# of Citations), and log (1+ #of Citations/patents) respectively. Since the innovation process requires significant time to produce patentable innovation, we examine the effect of Inventor CEOs on corporate innovation in subsequent periods (at t+1 and t+2). The results are consistent across across both time period measures so we only report the one period ahead measures. Z is a vector of firm and CEO level control variables (described in previous section) that have been found in the innovation literature to impact the innovation outputs.

Presumably, the innovation performance of high-tech firms in S&P 1500 would in part be driven by common unobserved year effects. As such, we incorporate year-fixed effects in our models. Following Zhou (2001), to estimate the real effects of Inventor CEOs on corporate innovation, which changes little over time but varies substantially across firms, we do not use firm-fixed effects in our specifications since inclusion of firm fixed effects absorbs any effect of Inventor CEOs. However, we expect differences in variability to be more systematically related to industry; thus, we use industry-fixed effects. Following Petersen (2009), we cluster standard errors at the firm level.

Table 3 reports the baseline findings. In columns 1 through 9, the coefficients of Inventor CEOs are both positive and significant. Specifically, we find that Inventor CEOs run firms are associated with approximately 27.64% more patents compared to non-Inventor CEOs run firms (column 1)[10]. In addition, these Inventor CEOs run firms are also associated with approximately a 27.64% higher citation count (column 2). This suggests that Inventor CEOs run firms file patents that are of higher quality. Further, these firms are also associated with approximately 25.34% more average citations (column 3) underscoring their impactful innovation. Since innovation can materialize over long periods of time, we also run the regressions using two-year ahead forward-looking innovation measures ($year_{t+2}$). The unreported results show that a continued to find consistent association of Inventor CEOs with corporate innovation.

The sign and magnitude of other control variables are broadly consistent with literature. For example, the coefficient on R&D/Total Assets is positive and significant in all the regressions. Larger firms (Firm size) are associated with higher quantity and quality of innovations. Firm leverage is negatively associated with corporate innovation consistent with literature (Hall (2002)). We also find positive coefficient on Tobin's Q consistent with the literature (Lerner (1994)).

In specifications (4) through to (9) we also include additional control variables that could explain the Inventor CEO effect. These are a Founder CEO effect, a measure of CEO overconfidence and measure of whether the CEO is a generalist or a specialist from Custodio et al (2017). Our result continues to hold even after controlling for these effects.

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[10] The mean value of Patents (t+1) is 1.7553. Therefore, the economic magnitude is calculated as $\boldsymbol{\beta}/Patents(t+1)/$ or 0.485/1.7553 or 27.64%. Similarly, we calculate such magnitude for Citations $_{(t+1)}$ and Average Citations $_{(t+1)}$.

In Table 4 we focus on studying the effect of Inventor CEO heterogeneity on firm level innovation. In particular, we examine the effect of the Innovation Active CEOs and High and Low Impact Inventor CEOs as defined in the previous section. In line with our expectations, the firm-level innovation effects of Inventor CEOs are intensified when the firm is run by an Innovation Active or a High impact CEO. In column (9) we exclude Innovation Active CEOs to ensure that we can establish an independent effect of High-impact inventors, who were active in the past but not presently. The results support the notion that corporate innovation outcomes tend to be superior, when the CEO has past high impact inventor experience, but does not actively invent during their tenure.

3.2 Do Inventor CEOs spur Radical Innovation?

In this section we test whether Inventor CEOs, on average, are associated with radical or break-through innovations.[11] We define radical innovation as those patents in industry-year pairs that have been cited the maximum number of times thereby indication that they are highly influential and radical in nature. Specifically, 'Radical Innovation' is dummy variable taking the value one if the firm has filed the patent that accumulated the maximum number of citation in the industry-year pair. This construction of innovation measure is similar to 'tail innovations' as in Acemoglu et al. (2014) who define tail innovation using overall citations distributions (specifically, patents cited at the 99th percentile of the citations distribution). We report the results of the regressions in Table 5. In columns 1 through 3, we report the results from the logit model. In the

[11] In motivating their study on openness to disruption and creative innovation, Acemoglu et al. (2014) provide two examples of radical innovation: 1) "systems and methods for selective electrosurgical treatment of body structures" by the ArthroCare Corporation which garnered 50 citations (compared to median citations of four within field of drugs and medical innovation) and 2) "method and system for placing a purchase order via a communications network" by Amazon which garnered citations 263 citations (compared to median citations of five within the technology class) within five years (2088 citation as of date)11. Interestingly, both firms are also among the firms run by Inventor CEOs in our sample. In case of Arthrocare Corporation, CEO Michael A. Baker is an active innovator awarded with as many as 12 patents. In the second example, Jeffrey P. Bezos himself is one of the four co-patentees of this radical innovation and thus an Inventor CEOs as per our definition.

last column, we report the results form a liner probability model. Overall, we show that Inventor CEOs run firms are associated with higher probability of filing patents that are radical in nature.

We also examine whether the likelihood of filing ground breaking patents is higher among those Inventor CEOs who are either Innovation Active or who have a history of high impact patents as Inventors. The results show that when CEOs are actively involved their firm's innovation and/or when they have a history of high impact patents, their firm is more likely to responsible for radical innovations. Therefore, these Inventor CEOs are associated with innovations that cause the most fundamental "creative destruction" (Acemoglu et al. (2014)).

3.3 Does an Inventor CEO's Specific Technology Class Experience Matter?

In this section we breakdown an Inventor CEO's past experience before becoming CEO into various technology classes, defined by the USPTO. In total, there are 430 different technology classes under which patents can be registered. Once we determine the classes in which the CEO has patents, the next step is to determine the distribution of a firm's newly registered patents across these same technology classes in every sample year. This is defined as the percentage share of a firm's total registered patents in each sample year, that occurs in each of the possible 430 technology classes. For every firm-year, the percentage of patents across all technology classes must sum to one.

We then estimate several OLS regression models to determine how a CEO's patent-technology-class experience is related to the firm's patent outputs. In this analysis, the unit of observation is a firm-year-technology class. The dependant variable in this regression is the percentage of a firm's patents in a given year that are registered in each class. The key explanatory variable is an indicator variable equal to one when the CEO is an Inventor with prior personal patenting experience in the given technology class, and zero otherwise.

We also control for a number of other firm factors that could explain variations in the share of patents produced in a given class. The first is a firm's patent breadth, defined as the number of patent classes in which the firm holds patents. As the firm expands the number of patent classes in which it innovates, then the share of patents in each class should mechanically fall. Second, we control for firm size, as larger firms may be more capable of producing patents across a more diverse range of classes. Finally we control for a firm's research and development expenditure, as this can also explain the number and diversity of new patents being registered. We drop many of the controls used in earlier models, as there does not appear to be any economic rationale for these controls to influence the distribution of patents across different classes, which is our main concern here.

The results are in reported Table 6. We report a variety of specifications, that vary based on the level at which we impose fixed-effects, and on whether control variables are included. Regardless of the specifications used, the Inventor CEO class experience dummy is consistently positive and statistically significant and maintains a strikingly consistent economic magnitude. Specifically, in years where a firm has an Inventor CEO with experience in a technology class, a firm's share of patents registered in that class increases by around 7 to 8 percentage points. Given that the mean share of patens in a class is 8.29 percent (based on firm-years with patents), then this represents a doubling of a firm's focus on particlar techology class when a CEO has experience in this class.

Finally, we examine whether a CEO's specific experience increases the likelihood that a firm produces radical innovation in a particular technology class. We define a firm as having radical innovation in a particular class, if one of the patents registered by the focal firm within that technology class in a year is cited in the 99th (or 90th) percentile of the citations distribution of a patent-class-year. If this is the case then we specify the dependant variable, *Radical Innovation 99th Percentile* as being equal to 1 and zero otherwise. The independent variables are the same as those in in Table 6, with one exception. We include the total number of patents registered by a firm in a year as an additional control, as a greater volume of patenting may mechanically increase the likelihood that a firm produces a patent that becomes highly cited. The results reported in Table 7 indicate an Inventor CEO's technology class experience, significantly increases the likelihood that their firm generates radical innovation in that same class.

4 Identification Strategies

4.1 Exogenous CEO turnovers

As mentioned earlier, it is likely that highly innovative firms or firms with higher innovation potential may hire Inventor CEOs who would ideally suit such organizational settings. Inventor CEOs may also wish to join more innovative firms to exploit their potential. Thus, the relationship that we find could be plagued by endogenous matching of Inventor CEOs to highly innovative firms. Claiming causality thus hinges on identifying a source of exogenous variation in CEOs that potentially breaks this endogenous matching link. To tackle this endogeneity issue, ideally one would like to have a natural experiment where one can randomly assign Inventor CEOs to firms and observe the outcome of interest. Unfortunately, this is not feasible. Another alternative could be to observe changes in CEO position caused by sudden death and study how that affect corporate innovation. However, limited observations on sudden CEO deaths for the panel under study, renders such tests infeasible again. Alternatively, one could study all CEO turnovers, in general, and study the effect of such incidents on corporate innovation as in Galasso and Simcoe (2011) and Sunder et al. (2016). However, as documented in the literature, many CEO transitions are also highly endogenous since it is possible that CEO turnovers are related to the variable of interest.

To overcome this probable endogenous matching of Inventor CEOs by innovative firms and provide causal evidence, we rely on data in Eisfeldt and Kuhnen (2013) that classifies CEO turnovers during the period 1992-2006 as exogenous, forced and unclassified turnovers.[12] They identify a CEO turnover as exogenous if the CEO departures were announced at least six months before the succession, or caused by a well-specified health problem. A similar approach (age based natural retirements as exogenous cases of managerial changes) is followed in Denis and Denis (1995) and Weisbach (1995). As argued in the literature (e.g., Fee, Hadlock and Pierce (2013)), we do not use forced CEO turnovers and unclassified CEO turnovers since these events are highly endogenous (e.g., Weisbach (1988), Warner, Watts and Wruck (1988), Fee and Hadlock (2000)).

Methodologically, we follow CEO switching analysis as in Galasso and Simcoe (2011), however deviate in terms of event selection. Galasso and Simcoe (2011) use 28 cases of CEO switching, regardless of CEO change type (endogenous or plausibly exogenous). To deal with the endogeneity of CEO transitions, we conduct analysis on a matched sample of only exogenous CEO turnovers. For "exogenous CEO turnovers" involving Inventor CEOs (our treated firms), we find corresponding matched firm-year observations of exogenous CEO turnover events where a non-Inventor CEOs was replaced by another non-Inventor CEOs (counterfactual turnover firms). More importantly, we also require that the matched event should be from the same 2 digit SIC and within certain range of firm size.[13] When we merge the Eisfeldt and Kuhnen (2013) data with our sample, we find 372 events of CEO changes of which 77 are exogenous CEO turnovers. Of these 77 exogenous CEO turnovers, 15 CEO turnovers involve a transition from 'Inventor CEOs' to non-Inventor CEOs. From the remaining exogenous CEO turnovers, we find the corresponding matches following the matching criteria described above. Notably, we do not include those exogenous turnover events where an Inventor CEOs was replaced by another Inventor CEOs or a non-Inventor CEOs was replaced by an Inventor CEOs to conduct a cleaner test. We retain data for firm-year observations from 3 years

[12] https://sites.google.com/site/andrealeisfeldt/ .

[13] We use within 15% of focal firm size to consider a probable match.

before exogenous CEO turnover and 3 years after such exogenous turnover events for both the treated and the control firms.

We employ firm fixed effects specification in this matched sample of CEO turnover analysis since we have variations (by construction) in our main explanatory variable- Inventor CEOs. Specifically, we run the following regression

$$Innovation_{i,t+n} = \alpha + \beta \, Treated\, firm\, dummy + \gamma \, Exogenous\, turnover + \delta \, Tretade\, firm\, dummy * Exogenous\, Turnover + Year_t + Firm_i + \varepsilon_{i,t} \quad (2)$$

Treated firm dummy is a dummy variable that takes the value 1 (both in pre and post exogenous turnover events) if the firm has experienced a CEO transition of Inventor CEOs to non-Inventor CEOs or 0 otherwise for control firms (that is 0 if transition is from non-inventor to non-Inventor CEOs). Exogenous turnover is a dummy variable taking the value 1 in periods following such exogenous turnover and 0 for pre-exogenous turnover. The coefficient on interaction term (Treated firm * Exogenous turnover) is of particular interest. If there is any causal effect of Inventor CEOs on corporate innovation, we would expect a negative coefficient on this interaction terms since the exogenous change of Inventor CEOs to non-Inventor CEOs should cause a decline in innovation efficiency. One more confounding factor that we should consider is unobservable time invariant firm-level characteristics that could simultaneously determine changes in CEO position and corporate innovation outcome. We take this into account by employing firm-fixed effects with and without other potentially important firm and CEO characteristics that we observe such as Firm size, R&D to Assets, CAPEX to Asset, log (Tobin's Q) and Founder-CEO status.

We report the results of the regressions in Table 8. In column 1, we find that the interaction term is negative and significant implying that corporate innovations of firms experiencing a transition from Inventor CEOs to non-Inventor CEOs decline significantly compared to those of firms where non-Inventor CEOs were replaced by other non-Inventor CEOs. We show that, post-exogenous CEO turnover, corporate innovation increases for firms in general. However, for firms run by Inventor CEOs, we show an economically sizable and statistically significant reduction in corporate innovation post exogenous CEO turnover, thereby implying that the relationship between Inventor CEOs and corporate innovation is causal with causation running from Inventor CEOs to innovation.

4.2 Quasi-natural experiment using R&D Tax Credit Shocks.

In this section, we design a quasi-natural experiment using the staggered changes of R&D tax credits across U.S. states and over time to examine whether the Inventor CEOs responded differently to changes in incentives to innovate. This strategy enables us to find plausibly exogenous sources of variation in incentives to innovate.

More importantly, the staggered nature of the changes in R&D tax credit (shocks) allows us to create appropriate counterfactual firms. We use two counterfactuals to conduct two tests. First, we construct a set of non-Inventor CEOs (control firms) from the states that have induced R&D tax credit shocks and compare their responses against those of Inventor CEOs (treated firms) from the same shock inducing states both in pre and post shock periods. This is methodologically similar to Almeida, Kim and Kim (2015) which use Asian financial crisis of 1997 as a shock to study differential responses of Chaebol (treated firms) and Non-Chaebol firm (Control firms).

In our context, since both Inventor CEOs (treated firms) and non-Inventor CEOs (Control firms) are exposed to the same shock, this would enable us to provide causal evidence since such shocks are plausibly exogenous. More importantly, we create the sample of control firms by matching them with treated firms using pre-shock firm level covariates and industry of operation. We report the results in Panel A of Table 9. We show that the pre-treatment difference between the groups widens in the post-treatment period in favour of the Inventor CEOs. More importantly, the difference-in-differences is positive and significant which suggest that Inventor CEOs have a superior response to such innovation enhancing incentives in ways that provides their firms with competitive advantages.

However, the response of the Inventor CEOs to the shock can be driven by unobservable firm characteristics that are correlated with having an Inventor CEO. A related possibility is that Inventor CEO-run firms increase their innovation constantly over time, and this explains the difference documented earlier. To address this, we use our second set of counterfactual firms which comprise of Inventor CEOs from states that did not experience R&D tax credit shock. Within this group, any difference will not be driven by unobserved heterogeneity. Since we are comparing Inventor CEOs from states (e.g., California, Illinois) that experienced such shock (treated group) to Inventor CEOs from other states (e.g., New York, Massachusetts) that did not experience such a shock (control group), we can tease out whether Inventor CEOs proactively take advantage of the change in the tax environment. This would highlight their innovation-spurring ability as opposed to innovative firms who are just matched with Inventor CEOs, since for both groups CEO assignment has already occurred in pre-shock period.

Methodologically, this test is similar to Card and Kruger (1994) which compare the impact of increase in minimum wage in New Jersey (law enacting states) to that of eastern Pennsylvania (state that did not enact such law). In addition, following Card and Krueger (1994), we match the control firms with treated firms on important pre-shock dimensions. Specifically, we match the control firms based pre-treatment R&D intensity, pre-treatment firm size and Industry of operation. Since we compare changes in key outcomes from pre-shock period to post-shock period, our methodology "differences out" unobserved time-invariant heterogeneity. We provide the difference-in-difference Matching Estimator (DID-ME) in Panel B of Table 9.

In the pre-shock period, there is no statistically significant difference in innovation outcomes (patents (t+1)) of Inventor CEOs run firms from shock inducing states (treated firms) and Inventor CEOs run firms from states that did not induce such shocks (control firms). In the post shock periods, we find statistically significant positive difference in favor of the treated groups. More importantly, difference-in-differences is positive and significant suggesting that Inventor CEOs from states that experienced such shock outperformed the control group. This evidence underscores the innovation spurring ability of the Inventor CEOs as opposed to endogenous matching based explanations.

4.3 Propensity score matched sample

Though we control for observable firm and CEO characteristics in our baseline specification, linear controls may not be sufficient since Inventor CEO-run firms may differ systematically from non-Inventor firms. In this section we provide evidence on effect Inventor CEOs on corporate innovation using propensity score matching (PSM) technique. Specifically, we estimate propensity scores using all the control variables of baseline specification along with industry and year-fixed effects. After estimating the propensity scores, we match each treated firm-years to counterfactuals or control firm-year observations that (1) are from the exact same 2 digit SIC industry, (2) have estimated propensity scores that differ from treated firms propensity score by no more than 10% (Caliper 0.10). Each Inventor CEOs firm-year observation is matched to either one or two of its nearest neighbours.

The PSM procedure yields a more balanced sample of firm-year observations where the firm characteristics are similar. We report the results of regressions for this balanced sample in Table 10. In columns 1 through 4 (columns 5 through 8), we use one (two) matches per treated firm. We continue to find positive effect of Inventor CEOs on corporate innovation. Since this propensity score matched sample controls for observable differences between Inventor CEOs run firms and non-Inventor CEOs run firms, this PSM based analysis instils confidence in our interpretation by reducing the potential for endogeneity induced by selection bias.

4.4 Value creation by Inventor CEOs

While we have provided evidence suggesting a causal link between Inventor CEOs and corporate innovation, this need not be value enhancing for all firms. Inventor CEOs could be overinvesting in innovation. For example, some studies have documented dissatisfaction with corporate venture capital programs because CEO's make risky investments in early stage innovative projects that do not generate sufficient returns for shareholders. Further, Innovation Active CEOs, may become distracted from other important aspects of their executive role, and this may be value reducing. Another dimension of this problem is that Innovation Active CEOs could use corporate resources to pursue an activity (inventing) from which they derive personal enjoyment, but that is not value enhancing for shareholders.

We test whether Inventor CEOs indeed generate greater market value for shareholders. We use Tobin's Q as the dependent variable to measure market valuation and report the results in Table 11. We find that Inventor CEOs are associated with higher market valuation and the magnitude is both economically and statistically significant. The results are even stronger for Innovation Active CEOs. To make stronger causal claims about this results we examine the same set of exogenous CEO turnovers used in our previous analysis, to examine the valuation consequences of an exogenous transition from an Inventor to Non-Inventor CEO. The results in Column (4) of Table 11, are in line with the aggregate correlation from the broader sample. This suggests that Inventor CEOs indeed create value for the shareholders they serve in addition to playing an important economic function by spurring high impact innovation.

5 Economic Channels through which Inventor CEOs Facilitate Innovation

5.1 The Acquisition Behaviour of Inventor CEOs

While we conjecture that Inventor CEOs can spur greater innovation at their firms for various reasons, our evidence thus far does not nail down any specific channels through which this occurs. In this section, we focus on whether the investment decisions of Inventor CEOs reflect a superior ability to identify and evaluate innovation-intensive investment opportunities. To do this we focus on acquisitions made by firms in our sample. Acquisitions are among the largest investment decisions made by firms and importantly, possess many observable characteristics that make it possible to identify differences between the acquisition behaviour of Inventor versus non-Inventor CEOs.

We expect that Inventor CEOs have a greater ability to evaluate the innovative potential of investment projects because of their own first-hand knowledge of the innovation process. In the context of the M&A market, this advantage has several testable empirical implications. First, we expect that Inventor CEOs should exploit their information advantage to acquire other innovation-intensive firms. Second, their advantage should be most valuable when it is hard to value the innovation intensive assets of the target, and third such acquisitions by Inventor CEOs should create more value for shareholders relative to similar acquisitions conducted by non-inventor CEOs.

We test these predictions by assembling a set of acquisitions made by our sample firms from the SDC database from 1992-2008. In deal selection, we follow Masulis, Wang and Xie (2007). Specifically, we require the following criteria:

1. The Acquisition is complete.
2. The acquirer controls less than 50% of the shares prior to the announcement and owns 100% of the target's share after the transaction.
3. The deal value is more than $ 1 million and at least 1% of the acquirer's market value of equity measured on the 11^{th} trading day prior to the announcement date.
4. The Acquirer has annual financial statement information available from Compustat and stock return data from CRSP.

Our first empirical test focuses on whether Inventor CEOs target firms with greater patent intensity. To test this, we employ logistic regression where the dependent variable is an indicator variable which takes the value 1 if the target in a M&A deal is a firm that has received patent grants in the past. The results in Table 12, column 2 show that the Inventor CEO dummy is positive and statistically significant and thus suggest that Inventor CEOs are more likely to select innovative firms as targets. An alternative interpretation of this results, is that Inventor CEOs may also be better able to integrate the technologies of both the acquirer and target.

Next, we examine whether Inventor CEOs have a greater propensity to acquire private targets. Presumably private targets should have greater information asymmetry and thus inventor CEOs should have a greater advantage in making value accretive acquisition decisions with respect to these firms. We test this in columns 1 of Table 12 where the dependent variable is an indicator that takes the value 1 if the target in a M&A deal is a private firm. The results in suggest that indeed Inventor CEOs have a greater propensity to acquire private firms.

An inventor CEO's decision to acquire private innovative targets can be risky for shareholders given the information asymmetry surrounding such deals. Thus, our final test seeks to determine whether such deals are perceived to be value enhancing. In particular, we explore whether the innovation-specific experience of a CEO impact the market's perception of a quality of a deal. To test this implication, we calculate 5-day cumulative abnormal returns (CARs) during the window encompassed by event days (-2, +2), where event day 0 is the announcement day of acquisition (Masulis et al. (2007)). We also control for other determinants of acquirers returns following the M&A literature. Specifically, we control for host of firm level characteristics such as firm size (Moeller, Schlingemann, and Stulz (2004), leverage (Garvey and Hanka (1999)), Cash to assets ratio (Jensen (1986)), Tobin's Q (Lang, Stulz, and Walking (1991); Servaes (1991); and Moeller et al. (2004)) among other control variables. We also control for our baseline

CEO characteristics. In addition, we control for deal-specific characteristics such as public target indicator and private target Indicator (Fuller, Netter, and Stegemoller (2002), relative deal size (Asquith, Brunner, and Mullins (1983); Moeller et al. (2004)), diversifying deal indicator (Morck, Shleifer, and Vishny (1990)). Controlling for a host of factors that can affect acquisition announcement returns, we find that acquiring firm led by an Inventor CEO experience significantly higher announcement returns. The coefficient estimates in Table 13 suggest that Inventor CEOs increase firm value by about 0.8% from M&A deal announcements. Panel B of Table 13 Indicates that Innovation active CEOs have an even larger effect.

Inventor CEOs' advantage in valuing the innovation intensive assets of the target should be most valuable when the information asymmetry is high. Specifically, when the target firms are private and /or have patent portfolios, the market should weigh in the first-hand innovation experience of the Inventor CEOs more positively. To test this hypothesis, we conduct two separate tests. First, we split the sample into private targets and non-private targets. Second, we split the sample based on whether the target is a private firm that also has received patents in the past. We present the results of these tests in columns 2 and 3 (Private vs. non-private split) and in columns 4 and 5 (Private and innovative targets vs. non-private and non-innovative targets) of Table 13. The results indicate that the magnitude of this effect is around 1.4 percentage points, on an average, when the target firms are private. More importantly, we find even more strong market response of about 3 percentage points for Inventor CEOs when the targets are private and innovative firms. The economic magnitude of this effect is quite significant given that on average the announcement returns to an acquisition on a target firm is about 0.17%, in our sample. In Panel B of Table 13 we find that the effect of Innovation Active CEOs to be even larger.

5.2 Market reactions to Major Product Announcements

In this section, we provide additional evidence on incremental value creation using abnormal positive stock market reactions from major product announcements. Since Inventor CEOs cause higher innovation productivity, it is more likely that such innovation success would translate to introduction of breakthrough products. Chaney and Devinney (1992) provide direct evidence on firms' earning significant excess return on announcing new products or services. They also show that truly new product or innovations are shown to outperform the simple reformulation of existing products. Since we document that Inventor CEOs run firms generate radical innovation or breakthrough innovations, the likelihood of introducing truly new products by Inventor CEOs run firms would be high. As such, Inventor CEOs run firm are more likely to generate incremental value from positive abnormal announcement returns from announcements of such breakthrough products. We test this conjecture by collecting data on new product announcement returns from Mukherjee, Singh and Zaldokas (2016)[14] and present the results in Table 14.

Mukherjee et al. (2016) combine textual analysis with event studies on stock market returns to construct the new product announcement returns. They implement event study methodology by fitting a market model over (-246,-30) period, and then estimate cumulative abnormal returns over the three (-1, 1) day period around a firm corporate press release related to product announcement. Specifically, in column 1 we show that Inventor CEOs run firms enjoy approximately 20 basis point higher announcement returns over the year and this is both economically and statistically significant. In column 2, we show that response is slightly higher for Innovation Active CEO. Column 3 indicates that High-impact Inventor CEOs also experience significant positive announcement returns, although they are not as large.

[14] https://sites.google.com/site/abhiroopmukherjee/

We also run regressions o the log of number of new product announcements with cumulative returns above the 75 percentile as dependent variable in Columns (5), (6) and (7). A positive coefficient (large and statistically significant) confirms our conjecture that all types of Inventor CEOs indeed are associated with more breakthrough product announcements. Thus, this test provides direct evidence on incremental value creation by the Inventor CEOs.

6 Conclusion

In this paper we show that Inventor CEOs are more capable of stimulating high quality innovation within the organizations they lead. We identify Inventor CEOs as those who have patents in their own names and hence possess demonstrated ability and first-hand experience in innovation. We argue that inventor CEOs hand-on personal experience endows them with a superior ability to select and evaluate innovative investment opportunities.

We use exogenous CEO turnover as an identification strategy to infer causality. The evidence is suggestive of causal relationship between Inventor CEOs and corporate innovation with causality running from Inventor CEOs to innovation. Exploring the channels through which Inventor CEOs spur greater innovation at their firms, we find evidence consistent with the notion that they possess a superior ability to identify innovative investment opportunities and products. We contribute to the understanding on the effect of CEO characteristics on firms' outcome by offering a new identifiable CEO characteristic that is measurable, independently verified under rigorous scrutiny of patent examiners of a USPTO and is meaningfully related to an important firm outcome.

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Table 1. Sample Distribution of Inventor CEOs

This table provides the breakdown of the number of Inventor CEOs, Non-Inventor CEOs and the percentages of Inventor CEOs by year and by industry groups. (excludes financials and regulated utilities).

Panel A: Sample distribution by year

Year	Non-Inventor CEOs	Inventor CEOs	Inventor CEOs (%)
1992	146	23	13.6%
1993	166	26	13.5%
1994	168	31	15.6%
1995	186	37	16.6%
1996	200	37	15.6%
1997	225	48	17.6%
1998	233	57	19.7%
1999	223	61	21.5%
2000	236	60	20.3%
2001	251	58	18.8%
2002	261	57	17.9%
2003	255	64	20.1%
2004	239	61	20.3%
2005	208	63	23.2%
2006	231	55	19.2%
2007	266	66	19.9%
2008	262	61	18.9%
Total	3,756	865	18.7%

Panel B: Sample distribution of Inventor CEOs by Fama-French 12 Industry groups

Industry	#of Non Inventor CEOs	# of Inventor CEOs	Inventor CEOs (%)
Medical Equipment	250	132	34.6%
Communication	325	19	5.5%
Business Services	970	106	9.9%
Computers	597	121	16.9%
Electronic Equipment	1,204	395	24.7%
Measuring and Control	410	92	18.3%
Total	3,756	865	18.7%

Panel C: Distribution by cumulative number of patents granted to Inventor CEOs

Cumulative # of Patents up to 2008	# of CEOs
1	48
2	19
>2	83
Total	150

Panel D: List of Inventor CEOs with more than 50 patent awards

CEO Name	Company Name
Steve Jobs	Apple Inc.
Jerome Swartz	Symbol Technologies
Eli Harari	Sandisk Corp
Donald R. Scifres	SDL inc.
Balu Balakrishnan	Power Integrations Inc.
Stephen P. A. Fodor	Affymetrix Inc.
John C. C. Fan	Kopin Corp
Navdeep S. Sooch	Silicon Laboratories Inc
Fred P. Lampropoulos	Merit Medical Systems Inc
John O. Ryan	Rovi Corp
Samuel H. Maslak	Acuson Corp
George A. Lopez	ICU medical Inc.

Panel E: Innovation-Active CEOs among the Inventor-CEOs sample

Year	Innovation Active CEOs		% of Innovation Active CEOs
	No	Yes	
1992	9	14	60.9%
1993	8	18	69.2%
1994	13	18	58.1%
1995	18	19	51.4%
1996	19	18	48.6%
1997	24	24	50.0%
1998	23	34	59.6%
1999	21	34	61.8%
2000	23	37	61.7%
2001	21	37	63.8%
2002	23	34	59.6%
2003	33	31	48.4%
2004	30	31	50.8%
2005	35	28	44.4%
2006	34	21	38.2%
2007	44	22	33.3%
2008	44	17	27.9%
Total	428	437	50.5%

Table 2. Summary Statistics

This table presents summary statistics for select variables used in this study. T-test (Wilcoxon-Mann-Whitney tests) are conducted to test for differences between the means and (medians) for firm-year observations with and without Inventor CEOs. Variable definitions are provided in Appendix. *,**,*** denote significance level at the 10%, 5%, and 1% level, respectively.

Variables	**Non-Inventor CEOs**				**Inventor CEOs**			
	N	Mean	Median	Std. Dev	N	Mean	Median	Std. Dev
Dependent variables								
No of Patents	3756	45.18	2.00	169.84	865	56.53*	8.00***	170.98
No of Citations	3756	600.39	8.00	2640.12	865	712.97*	57.00***	2455.31
Patents (t+1)	3756	1.63	1.10	1.83	865	2.31***	2.08***	1.77
Patents (t+2)	3586	1.58	0.69	1.85	835	2.16***	1.95***	1.84
Citation(t+1)	3756	2.55	1.61	2.80	865	3.54***	3.58***	2.70
Citations (t+1)	3559	2.39	1.10	2.78	808	3.19***	3.07***	2.74
Avg. Citations(t+1)	3756	1.18	0.57	1.35	865	1.60***	1.51***	1.32
Avg. Citations(t+2)	3559	1.07	0.34	1.30	835	1.38***	1.19***	1.28
Other variables								
Overconfident CEO (67)	3328	0.31	0.00	0.46	808	0.36***	0.00***	0.48
CEO Age	3634	53.15	53.00	7.74	845	53.10	53.00	8.46
Firm Size	3756	6.62	6.39	1.69	865	6.29***	6.02***	1.64
RD/Assets	3756	0.08	0.07	0.08	865	0.10***	0.09***	0.07
CAPEX	3756	0.05	0.04	0.05	865	0.06***	0.04**	0.05
Firm Age	3756	2.48	2.56	0.88	865	2.37***	2.48***	0.79
Leverage	3756	0.13	0.04	0.17	865	0.10***	0.01***	0.15
Tobin's Q	3756	0.79	0.69	0.59	865	0.90***	0.82***	0.63
CEO Tenure	3756	7.82	6.00	6.92	865	12.03***	10.00***	8.85
Volatility	3355	1.00	0.95	0.43	826	0.98	0.93	0.46
Founder-CEO	3756	0.21	0.00	0.41	865	0.54***	1.00***	0.50
Board size	2545	8.14	8.00	2.32	600	7.63***	7.00***	2.03
Co-option	1915	0.48	0.45	0.31	442	0.61***	0.67***	0.35

Institutional Holdings (%)	2824	0.79	0.85	0.21	740	0.74***	0.80***	0.24
CEO ownership	3517	0.02	0.00	0.06	799	0.05***	0.01***	0.09
CEO Equity-based pay	2951	0.44	0.49	0.33	672	0.46	0.53	0.35
Delta	3474	943.46	212.75	5726.46	775	7742.07***	307.82***	47081.80
Vega	3620	125.04	44.85	311.53	811	147.00*	45.76	423.05

Table 3. Inventor CEOs and Innovation outputs

The table presents results of regressing innovation outputs on *Inventor CEO*. *Inventor CEO* is equal to one if the CEO has at least one patent issued in her own name from US Patent and Trademark office (USPTO). *Tobin's Q* is defined as (book value of assets-book value of equity +market value of equity) /book value of assets. *Firm Size* is the natural log of book value of Asset of the firm. *Firm-age* is the Log of firm age where firm age is the number of years since the inception of the firms. *CAPEX* is Capital expenditure scaled by Assets. Missing values are coded with zero. *R&D/Assets* is Research and development expenditures scaled by total assets. Missing values are coded with zero. *Leverage* is defined as (long-term debt+ Short-term debt) /Total assets. CEO-Tenure is the CEO tenure in years. *PhD (STEM)* is an indicator variable equal to one for CEOs with PhD in Science, Technology, Engineering and Mathematics and zero otherwise. *Technical Education* is an indicator variable equal to one for CEOs with undergraduate or graduate degrees in engineering, physics, operation research, chemistry, mathematics, biology, pharmacy, or other applied science and zero otherwise. *MBA* is an indicator variable equal to one if the CEO received MBA degree or zero otherwise. No school information is an indicator equal to one if we cannot identify the CEOs' undergraduate school and zero otherwise. *Founder CEO* is equal to one if the CEO is a founder of the firm or CEO since the founding year of the firm. *Overconfident CEO (67)* is an indicator variable equal to one for all years after the CEO's options exceed 67% moneyness and zero otherwise. General Ability Index (GAI) is as defined in Custodio et al. (2013). All regressions include year and industry (based on two digit SIC code) fixed effects. Dependent variables in Columns 1, 2 and 3 are *Patents,* defined as log (1+#of patents) at time (t+1), *Citations,* defined as log (1+# of *Citations*) at time (t+1) and *Avg. Citations* is defined as log(1+ *Average Citations*) scaled by total patents. Columns (4)-(9) examine the effect of alternate control variables. Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Patents	Citations	Avg. Citations	Patents	Citations	Patents	Citations	Patents	Citations
Inventor CEO	0.485***	0.741***	0.319***	0.457***	0.717***	0.420***	0.636***	0.460***	0.636***
	(4.153)	(4.425)	(4.271)	(3.797)	(4.118)	(3.660)	(3.884)	(3.300)	(3.295)
Firm-size	0.677***	0.836***	0.197***	0.678***	0.837***	0.754***	0.905***	0.774***	0.908***
	(16.027)	(15.887)	(9.460)	(16.067)	(15.917)	(16.961)	(16.877)	(14.788)	(14.103)
RD/Assets	4.266***	5.841***	2.180***	4.303***	5.873***	4.519***	5.981***	6.249***	8.171***
	(6.752)	(6.317)	(5.106)	(6.802)	(6.349)	(7.120)	(6.478)	(6.653)	(6.479)
CAPEX	2.998***	3.936***	0.602	2.988***	3.928***	3.125***	3.698***	3.323***	4.119***
	(3.078)	(2.942)	(1.105)	(3.062)	(2.934)	(3.010)	(2.597)	(2.768)	(2.599)
Firm-Age	0.107*	0.046	-0.069*	0.123*	0.060	0.110	0.066	0.126	0.120
	(1.734)	(0.541)	(-1.867)	(1.957)	(0.687)	(1.602)	(0.715)	(1.549)	(1.103)
Leverage	-0.742***	-0.983***	-0.297	-0.740***	-0.981***	-0.907***	-1.098***	-0.757**	-0.758

	(-2.954)	(-2.638)	(-1.621)	(-2.943)	(-2.633)	(-3.326)	(-2.729)	(-2.262)	(-1.567)
Log(Tobin's Q)	0.242***	0.357***	0.130***	0.233***	0.350***	0.247***	0.361***	0.265***	0.433***
	(3.488)	(3.654)	(2.959)	(3.329)	(3.546)	(3.401)	(3.529)	(3.069)	(3.635)
CEO Tenure	-0.008	-0.008	-0.000	-0.013**	-0.013	-0.005	-0.006	-0.006	-0.007
	(-1.553)	(-1.119)	(-0.027)	(-2.262)	(-1.463)	(-0.862)	(-0.763)	(-0.981)	(-0.799)
PhD (STEM)	0.178	0.110	-0.037	0.166	0.100	0.181	0.111	0.326**	0.311
	(1.295)	(0.549)	(-0.399)	(1.207)	(0.500)	(1.301)	(0.550)	(2.273)	(1.591)
Technical Education	0.023	0.148	0.131**	0.031	0.155	0.148	0.294**	0.046	0.154
	(0.223)	(1.024)	(2.050)	(0.302)	(1.072)	(1.415)	(1.979)	(0.366)	(0.879)
MBA	-0.011	0.007	0.024	0.003	0.019	-0.006	-0.050	0.058	0.103
	(-0.116)	(0.050)	(0.351)	(0.032)	(0.133)	(-0.061)	(-0.341)	(0.515)	(0.620)
No school information	-0.122	-0.201	-0.062	-0.100	-0.182	-0.066	-0.206	-0.010	-0.055
	(-0.895)	(-0.928)	(-0.539)	(-0.732)	(-0.834)	(-0.458)	(-0.901)	(-0.047)	(-0.181)
Founder-CEO Dummy				0.164	0.141				
				(1.364)	(0.750)				
Overconfident CEO (67)						-0.110	-0.076		
						(-1.072)	(-0.512)		
General Ability Index (GAI)								-0.022	-0.037
								(-0.443)	(-0.562)
Constant	-2.607***	-1.340***	1.123***	-2.676***	-1.400***	-3.135***	-1.684***	-3.342***	-1.889***
	(-7.969)	(-3.198)	(5.513)	(-8.179)	(-3.360)	(-9.323)	(-3.912)	(-7.480)	(-3.240)
Observations	4,621	4,621	4,621	4,621	4,621	4,136	4,136	3,189	3,189
Adjusted R-squared	0.561	0.540	0.457	0.562	0.541	0.589	0.568	0.583	0.568
Industry Fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year Fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y

Table 4. Inventor CEO Heterogeneity and Firm Innovation Outputs

The table presents results of regressing innovation outputs on *Inventor CEOs* having recent innovation experience and innovation experience of high impact and low impact considering the forward citations received by Inventor CEOs' patents. *Innovation Active-CEO* is equal to one if the CEO has at least one patent issued in her own name around 2 years of focal firm year from US Patent and Trademark office (USPTO). *High-Impact Innovation experience* is equal to 1 if the number of patents registered with the CEO as one of the assignees that accumulates above median number of patents-class-year adjusted citations is more than 2 (which is the median of the distribution of such impactful innovation by all the inventor CEOs) and is 0 otherwise. *Low-Impact Innovation experience* is equal to 1 if the number of patents registered with the CEO as one of the assignees that accumulates above median number of patents-class-year adjusted citations is less than or equal to 2 and is 0 otherwise. *Tobin's Q* is defined as (book value of assets-book value of equity +market value of equity) /book value of assets. *Firm Size* is the natural log of book value of Asset of the firm. *Firm-age* is the Log of firm age where firm age is the number of years since the inception of the firms. *CAPEX* is Capital expenditure scaled by Asset. Missing values are coded with zero. *R&D/Asset* is Research and development expenditures scaled by total assets. Missing values are coded with zero. *Leverage* is defined as (long-term debt+ Short-term debt) /Total assets. CEO-Tenure is the CEO tenure in years. *PhD (STEM)* is an indicator variable equal to one for CEOs with PhD in Science, Technology, Engineering and Mathematics and zero otherwise. *Technical Education* is an indicator variable equal to one for CEOs with undergraduate or graduate degrees in engineering, physics, operation research, chemistry, mathematics, biology, pharmacy, or other applied science and zero otherwise. *MBA* is an indicator variable equal to one if the CEO received MBA degree or zero otherwise. No school information is an indicator equal to one if we cannot identify the CEOs' undergraduate school and zero otherwise. All regressions include year and industry (based on two digit SIC code) fixed effects. Patents$_{(t+1)}$ is defined as log (1+# of patents) in time (t+1), Citations$_{(t+1)}$ is defined as log (1+# of Citations) in time (t+1) and Avg. Citations$_{(t+1}$ is defined as log(1+ average Citations) in time (t+1), where average citations are Citations scaled by patents, as dependent variables, respectively. Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Variables	Full Sample		Inventor CEO Sample		Full Sample		Full Sample		Exc. Innovation Active CEOs
	Patents	Citations	Patents	Citations	Patents	Citations	Patents	Citations	Patents
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Innovation-Active CEOs	0.865***	1.450***	0.699***	1.214***	0.265***	0.610***			
	(7.271)	(7.915)	(4.626)	(5.328)	(2.701)	(3.903)			
Low-impact innovation experience							0.246*	0.349*	-0.024
							(1.731)	(1.824)	(-0.146)
High-impact innovation experience							0.818***	1.290***	0.396*
							(6.199)	(6.360)	(1.842)
Firm-size	0.684***	0.849***	0.771***	0.893***	0.293***	0.316***	0.680***	0.842***	0.679***
	(16.277)	(16.373)	(10.128)	(9.050)	(5.208)	(2.810)	(16.120)	(16.105)	(15.182)

RD/Assets	4.317***	5.910***	2.923***	3.434**	0.449	0.950	4.229***	5.780***	4.416***
	(6.932)	(6.508)	(2.837)	(2.342)	(1.178)	(1.268)	(6.719)	(6.288)	(6.636)
CAPEX	2.865***	3.692***	2.768**	3.173*	0.864	1.207	3.072***	4.059***	3.006***
	(2.964)	(2.763)	(2.453)	(1.750)	(1.569)	(1.281)	(3.177)	(3.062)	(2.795)
Firm-Age	0.112*	0.056	-0.103	-0.221	0.103	0.237	0.114*	0.057	0.134**
	(1.828)	(0.667)	(-0.961)	(-1.376)	(1.044)	(1.368)	(1.847)	(0.672)	(2.082)
Leverage	-0.708***	-0.921**	-1.331**	-1.003	-0.110	0.063	-0.728***	-0.959**	-0.633**
	(-2.842)	(-2.503)	(-2.381)	(-1.335)	(-0.731)	(0.201)	(-2.906)	(-2.578)	(-2.470)
Log(Tobin's Q)	0.226***	0.328***	0.248**	0.394***	0.095**	0.170**	0.232***	0.341***	0.228***
	(3.246)	(3.375)	(2.176)	(2.618)	(2.535)	(2.517)	(3.364)	(3.513)	(3.017)
CEO Tenure	-0.009*	-0.010	-0.007	-0.015	-0.000	-0.001	-0.009*	-0.010	-0.009*
	(-1.719)	(-1.359)	(-0.755)	(-1.076)	(-0.101)	(-0.169)	(-1.747)	(-1.339)	(-1.670)
PhD (STEM)	0.194	0.121	0.192	0.216	-0.022	-0.153	0.139	0.046	0.143
	(1.490)	(0.646)	(0.986)	(0.829)	(-0.191)	(-0.744)	(1.029)	(0.231)	(0.935)
Technical Education	0.021	0.144	0.127	0.040	0.008	0.225	0.017	0.139	0.030
	(0.212)	(1.014)	(0.715)	(0.135)	(0.094)	(1.571)	(0.174)	(0.978)	(0.286)
MBA	0.001	0.029	-0.201	-0.172	0.069	0.033	0.007	0.036	0.018
	(0.011)	(0.208)	(-1.132)	(-0.574)	(0.850)	(0.227)	(0.068)	(0.253)	(0.180)
No school information	-0.094	-0.159	-0.146	-0.264	-0.103	-0.179	-0.115	-0.190	-0.059
	(-0.702)	(-0.755)	(-0.504)	(-0.572)	(-0.858)	(-0.832)	(-0.850)	(-0.890)	(-0.400)
Constant	-2.666***	-1.448***	-2.802***	-0.494	-0.537*	0.893	-2.645***	-1.404***	-2.730***
	(-8.320)	(-3.581)	(-5.384)	(-0.616)	(-1.715)	(1.412)	(-8.113)	(-3.402)	(-7.782)
Observations	4,621	4,621	865	865	4,621	4,621	4,621	4,621	4,184
Adjusted R-squared	0.569	0.552	0.621	0.635	0.312	0.448	0.565	0.545	0.556
Industry Fixed effects	Y	Y	Y	Y	N	N	Y	Y	Y
Year Fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-Fixed effects	N	N	N	N	Y	Y	N	N	N

Table 5. Radical innovation & Inventor CEO

The table presents results of regressing innovation outputs on *Inventor CEO*. *Inventor CEO* is equal to one if the CEO has at least one patent issued in her own name from US Patent and Trademark office (USPTO). *Innovation Active-CEOs* is equal to one if the CEO has at least one patent issued in her own name around 2 years of focal firm year from US Patent and Trademark office (USPTO). *High-Impact Innovation experience* is equal to 1 if the number of patents registered with the CEO as one of the assignees that accumulates above median number of patents-class-year adjusted citations is more than 2 (which is the median of the distribution of such impactful innovation by all the inventor CEOs) and is 0 otherwise. *Low-Impact Innovation experience* is equal to 1 if the number of patents registered with the CEO as one of the assignees that accumulates above median number of patents-class-year adjusted citations is less than or equal to 2 and is 0 otherwise. *Founder CEO* is equal to one if the CEO is a founder of the firm or CEO since the founding year of the firm. *Firm Size* is the natural log of book value of Asset of the firm. *Firm-age* is the Log of firm age where firm age is the number of years since the inception of the firms. *CEO Age* is the age of the CEO. *R&D/Asset* is Research and development expenditures scaled by total assets. Missing values are coded with zero. CEO ownership is defined as the ratio of the number of shares owned by the CEO after adjusting for stock splits to total shares outstanding. *Innovation Active-CEO* is equal to one if the CEO has at least one patent issued in her own name around 2 years of focal firm year from US Patent and Trademark office (USPTO). All regressions include year and industry (based on two digit SIC code) fixed effects. Columns 1 through 3 present results from employing logit regressions using *Radical Innovation* as the dependent variables. Columns 4 through 6 present results from employing Linear Probability Models using *Radical Innovation* as the dependent variables. Radical Innovation is defined as a dummy taking the value 1 if the patent has been cited the maximum number of times in an industry-year pair. Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	Logit Regressions			Linear Probability Models		
	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Inventor CEOs (Indicator)	0.639*			0.008*		
	(1.875)			(1.764)		
RD/Assets	5.947***	5.630**	5.341**	0.043***	0.053***	0.051***
	(2.666)	(2.431)	(2.238)	(2.698)	(2.850)	(2.771)
Firm-size	1.304***	1.321***	1.361***	0.015***	0.015***	0.015***
	(9.706)	(9.572)	(9.220)	(9.696)	(9.677)	(9.674)
Firm-Age	-0.198	-0.215	-0.199	0.000	-0.000	-0.000
	(-1.352)	(-1.449)	(-1.294)	(0.041)	(-0.188)	(-0.131)
CEO Age	-0.018	-0.024	-0.032	-0.000	-0.000	-0.000
	(-0.716)	(-0.910)	(-1.230)	(-0.605)	(-0.958)	(-0.920)
Founder-CEO	0.251	0.069	-0.240	-0.004	-0.003	-0.004

	(0.757)	(0.197)	(-0.656)	(-1.113)	(-1.045)	(-1.347)
CEO ownership	1.990	2.327	2.987	0.035**	0.043**	0.048***
	(1.051)	(1.147)	(1.522)	(2.015)	(2.313)	(2.748)
Innovation-Active-CEOs		0.905**			0.011*	
		(1.971)			(1.695)	
High impact Innovation experience			1.538***			0.016**
			(3.672)			(2.072)
Low impact Innovation experience			-0.228			-0.003
			(-0.448)			(-0.541)
Constant	-12.419***	-12.030***	-11.924***	-0.069***	-0.058***	-0.059***
	(-7.056)	(-6.923)	(-6.993)	(-3.897)	(-3.186)	(-3.193)
Observations	4,203	4,203	4,203	4,203	4,203	4,203
Adjusted R-squared				0.044	0.048	0.049
Industry fixed effects	Y	Y	Y	Y	Y	Y
Year Fixed effects	Y	Y	Y	Y	Y	Y

Table 6: The effect of an Inventor CEO's patenting experience on firm's patent technology class distribution.

This table presents the results of the regressions showing the directional effect of inventor-CEOs on firm level patenting focus. *CEOs' patent class relevant experience Indicator* is a variable that takes the value of 1 if the CEO has patenting experience in that focal technology class before becoming the CEO of the focal firm. *Patent Breadth* is the unique number of patent classes that the firm has registered patents with the USPTO in that year. *# of Patents in relevant class* is the total number of patents that has been applied for by the firm in the focal technology class. *Share of patent class in a yearly patent portfolio* is the fraction of a firms' patent portfolio in a given year that comes for patents in a given technology class. *R&D/Asset* is Research and development expenditures scaled by total assets. Missing values are coded with zero. All regressions include year, firm and technology class fixed effects as indicated. Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Share of patent class in yearly patent portfolio						
CEOs' patent class relevant experience indicator	0.078***	0.079***	0.073***	0.078***	0.079***	0.073***	0.073***
	(6.461)	(6.507)	(6.084)	(6.460)	(6.508)	(6.082)	(6.075)
Patent Breadth				0.000***	0.000**	0.000***	0.000***
				(5.567)	(2.501)	(5.045)	(5.036)
Firm Size				0.000***	0.000***	0.000***	0.000***
				(4.323)	(2.976)	(4.655)	(4.648)
RD/Assets				0.004***	0.000	0.004***	0.004***
				(6.006)	(0.879)	(6.108)	(6.098)
Constant	0.002***	0.002***	0.002***	0.000*	0.001***	0.000*	0.000
	(31.581)	(18.040)	(16.456)	(1.795)	(2.935)	(1.697)	(1.206)
Observations	1,423,268	1,423,268	1,423,268	1,423,268	1,423,268	1,423,268	1,423,268
R-squared	0.011	0.013	0.028	0.012	0.013	0.029	0.033
Year Fixed Effects	N	Y	Y	N	Y	Y	N
Patent Class Fixed Effects	N	N	Y	N	N	Y	N
Firm Fixed Effects	N	Y	N	N	Y	N	N
Patent class* year fixed effects	N	N	N	N	N	N	Y

Table 7: The predictive effect of an Inventor CEO's patenting experience on firm technology classes with radical innovation

This table presents the results of the regressions showing the directional effect of inventor-CEOs on firm level patenting success. *CEOs' patent class relevant experience dummy* is an indicator variable that takes the value of 1 if the CEO has patenting experience in that focal technology class before becoming the CEO of the focal firm. *Patent Breadth* is the unique number of patent classes that the firm has registered patents with the USPTO in that year. *# of Patents in relevant class* is the total number of patents that has been applied for by the firm in the focal technology class. Columns 1 through 5 use *Radical Innovation 99th Percentile* defined as an indicator variable taking the value of one if patents registered by the focal firm within that technology class in a year have been cited in the 99th percentile of the citations distribution of a patent-class-year as the dependent variables. Columns 6 through 10 use *Radical Innovation 90th Percentile* defined as an indicator variable taking the value of one if patents registered by the focal firm within that technology class in a year have been cited in the 90th percentile of the citations distribution of a patent-class-year as the dependent variables. *Firm Size* is the natural log of book value of Asset of the firm. *R&D/Asset* is Research and development expenditures scaled by total assets. Missing values are coded with zero. All regressions include year, firm and technology class fixed effects as indicated Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Radical Innovation indicator dummy defined using the citations distribution of a patent class-year at the									
	99th Percentile					90th Percentile				
CEOs' patent class relevant experience indicator	0.035***	0.035***	0.031***	0.022***	0.021**	0.153***	0.154***	0.133***	0.126***	0.112***
	(3.343)	(3.364)	(2.959)	(2.586)	(2.463)	(6.581)	(6.784)	(5.997)	(6.814)	(6.389)
Patent Breadth				0.000***	0.000***				0.001***	0.001***
				(2.798)	(3.362)				(7.180)	(8.642)
# of patents in relevant class				0.006***	0.005***				0.012***	0.012***
				(6.411)	(6.431)				(4.212)	(4.204)
Firm Size				-0.000	0.000				0.000	0.000
				(-0.257)	(0.033)				(0.986)	(1.451)
RD/Assets				-0.002*	-0.001				0.001	0.005**
				(-1.858)	(-0.827)				(0.902)	(2.421)
Constant	0.002***	0.001***	0.008***	0.001**	0.003*	0.008***	0.004***	0.035***	-0.000	0.017***
	(6.121)	(4.670)	(3.559)	(2.347)	(1.753)	(7.604)	(4.069)	(5.283)	(-0.452)	(3.573)

Observations	1,423,268	1,423,268	1,423,268	1,423,268	1,423,268	1,423,268	1,423,268	1,423,268	1,423,268	1,423,268
Adjusted R-squared	0.001	0.001	0.007	0.152	0.163	0.005	0.005	0.028	0.169	0.213
Year Fixed Effects	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Patent Class Fixed Effects	N	N	Y	N	Y	N	N	Y	N	Y
Firm Fixed Effects	N	Y	N	Y	N	N	Y	N	Y	N

Table 8. Exogenous CEO turnovers and Firm Level Patenting

The table presents results of regressing innovation outputs in the context of exogenous CEO Turnovers. The dependent variables are *Patents* defined as log (1+# of patents) at time (t+1), Citations defined as log (1+# of Citations) in time (t+1), and *Patents/R&D* is the log (# of patents/R&D Investments). *Exogenous CEO turnover* is as defined in Eisfeldt and Kuhnen (2013). *Treated firm* is a dummy variable taking the value 1 if exogenous CEO turnover involves a transition from Inventor CEO to Non-Inventor CEO and 0 Otherwise. *R&D/Asset* is Research and development expenditures scaled by total assets. Missing values are coded with zero. *Firm Size* is the natural log of book value of Asset of the firm. *Leverage* is defined as (long-term debt+ Short-term debt) /Total assets. *CAPEX* is Capital expenditure scaled by Assets. Missing values are coded with zero. *Tobin's Q* is defined as (book value of assets-book value of equity +market value of equity) /book value of assets. *Founder CEO* is equal to one if the CEO is a founder of the firm or CEO since the founding year of the firm. All regressions include year and 2 digit SIC based Industry or Firm Fixed effects (based on unique GVKEY) as indicated. Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)
Variables	Patents	Citations	Patents/R&D
Exogenous CEO turnover * Treated Firm dummy (a*b)	-0.473**	-0.175*	-0.068***
	(-4.818)	(-2.544)	(-5.858)
Exogenous CEO turnover: b	0.267**	0.451**	-0.015
	(4.469)	(4.946)	(-0.364)
RD/Assets	1.305	2.434	
	(0.591)	(1.496)	
Firm Age	0.150	0.465	-0.025
	(0.309)	(2.302)	(-0.736)
Firm size	0.293***	-0.114	-0.055
	(7.128)	(-0.495)	(-0.920)
Leverage	0.161**	-0.377	-0.056
	(3.708)	(-1.002)	(-1.384)
CAPEX	1.456	-1.165	-0.351
	(1.288)	(-0.695)	(-1.379)
Log(Tobin's Q)	0.219**	0.002	0.022
	(3.238)	(0.008)	(1.781)

Constant	-0.446	4.518	0.557
		(0.820)	(0.555)
Observations	233	233	233
Adjusted R-squared	0.303	0.413	0.155
Number of firms	41	41	41
Year Fixed effects	Y	Y	Y
Firm-Fixed effects	Y	Y	Y

Table 9. Quasi Natural Experiment Using State Level R&D Tax Credit Shocks

This table presents the changes in Patent (t+1) before and after the R&D tax credit shocks with the results of difference-in-difference tests for Inventor-CEOs and Non-Inventors CEOs. Panel A compares the Inventor CEOs run firms (Treated firms) and the Non-Inventor CEOs run firms (Control firms) from the same states that experienced R&D tax credit shocks. Panel B compares the Inventor CEO run firms from states that experienced R&D tax credit shocks (treated firms) and the Inventor CEO run firms from states that did NOT experienced R&D tax credit shocks (control firms). $Patents_{(t+1)}$ defined as log (1+# of patents) is the dependent variable. ***,**, and * indicates statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Inventor CEOs vs. Non-Inventor CEOs in states with R&D Tax credit shocks

Patents (t+1) before and after the R&D Tax credit shock (Inventor CEOs vs Non-Inventor CEOs)			
	Before	After	After-Before
Treated firms	2.982	3.669	0.687*
			(1.87)
Control Firms	2.061	2.19	0.129
			(0.85)
Difference (Treated-Control)	0.921***	1.479***	**0.558***
(t-statistics)	(3.95)	(6.35)	**(1.70)**
Matching Estimator (ATT)			0.348*
			(1.73)

Panel B. Inventor CEOs in states with R&D Tax credit shocks vs. Inventor CEOs in states without R&D Tax credit shocks

Patents (t+1) before and after the R&D Tax credit shock (Inventor CEOs vs Inventor CEOs)			
	Before	After	After-Before
Treated firms	2.459	3.939	1.48**
			(2.306)
Control Firms	2.606	2.560	-0.046**
			(2.567)
Difference (Treated-Control)	-0.146	1.379**	**1.525***
(t-statistics)	(-0.24)	(2.567)	**(1.86)**
Matching Estimator (ATT)			1.010***
			(3.44)

Table 10. Propensity Score Matched Sample Results

The table presents results of regressing innovation outputs on *Inventor CEO* from a propensity score matched sample. *Inventor CEO* is equal to one if the CEO has at least one patent issued in her own name from US Patent and Trademark office (USPTO). All regressions include year and industry (based on two digit SIC code) fixed effects. Columns 1 and 2 (3 and 4) present regressions of log (1+# of patents) ((log (1+ Citations)) as dependent variables. Columns 1 through 4 are based on one nearest neighbour matched firm-year observations. Columns 5 through 8 are based on two nearest neighbour matched firm-year observations. Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Inventor CEOs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	$\text{Patents}_{(t+1)}$	$\text{Patents}_{(t+2)}$	$\text{Citations}_{(t+1)}$	$\text{Citations}_{(t+2)}$	$\text{Patents}_{(t+1)}$	$\text{Patents}_{(t+2)}$	$\text{Citations}_{(t+1}$	$\text{Citations}_{(t+2)}$
Inventor CEOs (Indicator)	0.372***	0.286***	0.560***	0.427***	0.383***	0.326***	0.568***	0.465***
	(6.086)	(4.646)	(6.094)	(4.828)	(6.793)	(5.615)	(6.732)	(5.572)
Baseline Control variables	Y	Y	Y	Y	Y	Y	Y	Y
Industry-Fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Year Fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
# Nearest match			1				2	

Panel B: Innovation Active CEOs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	$\text{Patents}_{(t+1)}$	$\text{Patents}_{(t+2)}$	$\text{Citations}_{(t+1)}$	$\text{Citations}_{(t+2)}$	$\text{Patents}_{(t+1)}$	$\text{Patents}_{(t+2)}$	$\text{Citations}_{(t+1}$	$\text{Citations}_{(t+2)}$
Innovation Active	0.680***	0.582***	1.183***	0.951***	0.653***	0.558***	1.154***	0.923***
CEOs (Indicator)	(7.970)	(6.781)	(9.268)	(7.646)	(7.663)	(6.514)	(9.209)	(7.500)
Baseline Control variables	Y	Y	Y	Y	Y	Y	Y	Y
Industry-Fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Year Fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
# Nearest match			1				2	
Observations	4,621	4,394	4,621	4,394	4,621	4,394	4,621	4,394

Table 11. Inventor CEOs and Value Creation

The table presents results of regressing Log (Tobin's Q) on *Inventor CEO* and *Innovation-Active CEOs. Inventor CEO* is equal to one if the CEO has at least one patent issued in her own name from US Patent and Trademark office (USPTO). *Innovation Active-CEOs* is equal to one if the CEO has at least one patent issued in her own name around 2 years of focal firm year from US Patent and Trademark office (USPTO). *Tobin's Q* is defined as (book value of assets-book value of equity +market value of equity) /book value of assets. *Firm Size* is the natural log of book value of Asset of the firm. *Firm-age* is the Log of firm age where firm age is the number of years since the inception of the firms. Volatility is the volatility of stock returns. *Leverage* is defined as (long-term debt+ Short-term debt) /Total assets. *CAPEX* is Capital expenditure scaled by Asset. Missing values are coded with zero. CEO ownership is defined as the ratio of the number of shares owned by the CEO after adjusting for stock splits to total shares outstanding. CEO-Tenure is CEO tenure in years. *Founder CEO* is equal to one if the CEO is a founder of the firm or CEO since the founding year of the firms. ROA is defined as net income before extraordinary items and discontinued operations / book value of assets. Stock Return is firms' yearly stock return. *Exogenous CEO turnover* is as defined in Eisfeldt and Kuhnen (2013). *Treated firm* is a dummy variable taking the value 1 if exogenous CEO turnover involves a transition from Inventor CEO to Non-Inventor CEO and 0 Otherwise. All regressions include year and 2 digit SIC based Industry or Firm Fixed effects (based on unique GVKEY) as indicated. Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Variables	Log (Tobin's Q)			
	(1)	(2)	(3)	(4)
Inventors CEO (Indicator)	0.084*			
	(1.832)			
Innovation Active CEOs		0.138**	0.097*	
		(2.569)	(1.856)	
Firm-Size	0.063*	0.065*	-0.046	-0.057
	(1.834)	(1.880)	(-1.193)	(-0.436)
Firm Age	-0.149***	-0.149***	-0.313***	-0.563**
	(-5.750)	(-5.754)	(-5.757)	(-2.045)
Volatility	-0.086	-0.089	-0.458***	-0.819**
	(-1.156)	(-1.219)	(-3.848)	(-2.376)
Leverage	-0.697***	-0.687***	-0.407***	-0.597***
	(-6.362)	(-6.324)	(-4.304)	(-3.191)
CAPEX	1.178***	1.161***	1.379***	2.335***
	(3.218)	(3.230)	(4.891)	(3.276)
Log (Net Property, Plant & Equipment)	-0.033	-0.034	-0.011	-0.176**

	(-1.071)	(-1.103)	(-0.309)	(-2.337)
CEO Tenure	-0.001	-0.001	0.004	0.006
	(-0.405)	(-0.371)	(1.455)	(1.630)
CEO ownership	0.129	0.123	-0.142	0.225
	(0.451)	(0.440)	(-0.502)	(0.436)
Founder CEO	0.074	0.069	0.016	-0.174*
	(1.510)	(1.429)	(0.274)	(-1.742)
Stock Return	0.002***	0.002***	0.002***	0.003***
	(16.996)	(17.059)	(19.256)	(12.257)
ROA	0.340***	0.338***	0.163***	0.013
	(4.521)	(4.467)	(2.945)	(0.089)
Exogenous CEO turnover * Treated Firm dummy (a*b)				-0.210*
				(-1.942)
Exogenous CEO turnover: b				0.022
				(0.402)
Constant	0.646***	0.642***	1.724***	3.410**
	(4.075)	(4.040)	(9.528)	(2.561)
Observations	3,508	3,508	3,508	204
Adjusted R-squared	0.411	0.413	0.508	0.708
Number of Firms			475	40
Industry Fixed Effects	Y	Y	N	N
Year Fixed effects	Y	Y	Y	Y
Firm Fixed-Effects	N	N	Y	Y

Table 12. M&A Target Firm Selection of Inventor CEOs

The table presents results from employing logit regressions to study target selection in M&A by the Inventor-CEOs. Private Target Indicator is a variable that equals one if the target in M&A deal is a private firm. Innovative Target Indicator is a variable that equals one if the target has received patent in the past. *Inventor CEO* is equal to one if the CEO has at least one patent issued in her own name from US Patent and Trademark office (USPTO). *Innovation Active-CEOs* is equal to one if the CEO has at least one patent issued in her own name around 2 years of focal firm year from US Patent and Trademark office (USPTO). *High-Impact Innovation experience* is equal to 1 if the number of patents registered with the CEO as one of the assignees that accumulates above median number of patents-class-year adjusted citations is more than 2 (which is the median of the distribution of such impactful innovation by all the inventor CEOs) and is 0 otherwise. *Low-Impact Innovation experience* is equal to 1 if the number of patents registered with the CEO as one of the assignees that accumulates above median number of patents-class-year adjusted citations is less than or equal to 2 and is 0 otherwise. *Tobin's Q* is defined as (book value of assets-book value of equity +market value of equity) /book value of assets. *Firm Size* is the natural log of book value of Asset of the firm. *Firm-age* is the Log of firm age where firm age is the number of years since the inception of the firms. *CAPEX* is Capital expenditure scaled by Asset. Missing values are coded with zero. *R&D/Asset* is Research and development expenditures scaled by total assets. Missing values are coded with zero. *Leverage* is defined as (long-term debt+ Short-term debt) /Total assets. CEO-Tenure is the CEO tenure in years. *PhD (STEM)* is an indicator variable equal to one for CEOs with PhD in Science, Technology, Engineering and Mathematics and zero otherwise. *Technical Education* is an indicator variable equal to one for CEOs with undergraduate or graduate degrees in engineering, physics, operation research, chemistry, mathematics, biology, pharmacy, or other applied science and zero otherwise. *MBA* is an indicator variable equal to one if the CEO received MBA degree or zero otherwise. No school information is an indicator equal to one if we cannot identify the CEOs' undergraduate school and zero otherwise. *Founder CEO* is equal to one if the CEO is a founder of the firm or CEO since the founding year of the firm. *Cash/Assets* is cash scaled by Total Assets. Diversifying deal indicator is variable that equals one if the target and Acquirer differ in their Fama-French-12 industries (FF12) classification. *Relative Deal Size* is the ratio of the deal value and the market capitalization of the bidder. *Public Target Indicator* is a variable that equals one if the target in M&A deal is a Public firm. All regressions include year and industry (based on two digit SIC code) fixed effects. Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Private Target Indicator	Innovative Target Indicator	Private Target Indicator	Innovative Target Indicator	Private Target Indicator	Innovative Target Indicator
Inventor-CEOs (Indicator)	0.185***	0.391**				
	(2.911)	(2.371)				
Innovation-Active CEOs			0.426*	0.459*		
			(1.777)	(1.923)		
High impact innovation experience					0.213	0.702**
					(0.896)	(2.025)

Low impact innovation experience					0.166	0.181
					(0.887)	(0.657)
Firm-size	-0.293***	0.219***	-0.292***	0.223***	-0.293***	0.220***
	(-3.467)	(6.558)	(-3.589)	(3.205)	(-3.452)	(3.591)
RD/Assets	1.465	1.902	1.414	1.841*	1.462	1.867*
	(0.627)	(1.616)	(0.628)	(1.827)	(0.631)	(1.696)
CAPEX	0.013	1.120	-0.224	0.962	0.005	1.029
	(0.005)	(0.672)	(-0.081)	(0.730)	(0.002)	(0.716)
Log(Tobin's Q)	0.415***	-0.314**	0.418***	-0.312	0.416***	-0.309
	(3.555)	(-2.137)	(3.485)	(-1.605)	(3.481)	(-1.560)
Leverage	0.143	-0.560	0.114	-0.611	0.142	-0.586
	(0.652)	(-1.018)	(0.515)	(-0.623)	(0.622)	(-0.620)
CEO Tenure	-0.022	-0.015	-0.028	-0.019	-0.023	-0.019**
	(-0.522)	(-0.960)	(-0.744)	(-1.520)	(-0.558)	(-2.345)
CEO Tenure Squared	-0.000	0.001	-0.000	0.001	-0.000	0.001*
	(-0.144)	(1.432)	(-0.007)	(1.400)	(-0.144)	(1.868)
PhD (STEM)	0.388	0.189	0.381	0.207	0.384	0.142
	(1.569)	(0.826)	(1.533)	(0.621)	(1.517)	(0.450)
MBA	0.075	0.359**	0.076	0.347***	0.075	0.363***
	(0.592)	(2.529)	(0.566)	(2.769)	(0.589)	(3.441)
Technical Education	-0.112	0.394***	-0.100	0.413***	-0.111	0.406***
	(-1.095)	(2.816)	(-1.023)	(3.346)	(-1.107)	(3.599)
No school information	0.029	0.471	0.023	0.460***	0.027	0.452***
	(0.094)	(1.416)	(0.075)	(3.125)	(0.087)	(2.830)
Cash/Assets	1.055**	-0.729	1.005**	-0.729***	1.055**	-0.737***
	(2.375)	(-1.353)	(2.099)	(-4.275)	(2.379)	(-4.865)
Diversifying Deal Indicator	-0.080	-0.083	-0.088	-0.083	-0.080	-0.082
	(-0.393)	(-0.465)	(-0.424)	(-0.707)	(-0.394)	(-0.686)
Relative Deal Size	-1.202***	0.343**	-1.206***	0.338***	-1.203***	0.343***

	(-3.318)	(2.195)	(-3.328)	(3.125)	(-3.351)	(2.908)
Private target Indicator		-0.329***		-0.330***		-0.334***
		(-3.364)		(-2.782)		(-2.792)
Public target Indicator		0.487***		0.492***		0.482***
		(4.184)		(4.558)		(4.452)
Constant	2.012*	-2.216***	2.064*	-2.182***	2.014*	-2.192***
	(1.753)	(-6.597)	(1.907)	(-2.941)	(1.780)	(-3.174)
Observations	1,758	1,758	1,758	1,758	1,758	1,758
Industry Fixed Effects	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y

Table 13. M&A Cumulative Abnormal Announcement Returns

This table shows regressions of mergers' cumulative abnormal stock price returns of the Acquirer (CAR) on different manager, deal, and company characteristics. Five-day cumulative abnormal return (in percentage points) calculated using the market model. The market model parameters are estimated over the period (−210, −11) with the CRSP equally-weighted return as the market index following Masulis et al. (2007). Private Target Indicator is a variable that equals one if the target in M&A deal is a private firm. Innovative Target Indicator is a variable that equals one if the target has received patent in the past. *Inventor CEO* is equal to one if the CEO has at least one patent issued in her own name from US Patent and Trademark office (USPTO). *Innovation Active-CEOs* is equal to one if the CEO has at least one patent issued in her own name around 2 years of focal firm year from US Patent and Trademark office (USPTO). *High-Impact Innovation experience* is equal to 1 if the number of patents registered with the CEO as one of the assignees that accumulates above median number of patents-class-year adjusted citations is more than 2 (which is the median of the distribution of such impactful innovation by all the inventor CEOs) and is 0 otherwise. *Low-Impact Innovation experience* is equal to 1 if the number of patents registered with the CEO as one of the assignees that accumulates above median number of patents-class-year adjusted citations is less than or equal to 2 and is 0 otherwise. All regressions include year and Acquirer Industry interacted joint fixed effects. Baseline control variables and deal level control variables as in Table 10 are included in the models. Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Variables	CAR (-2, +2)				
Panel A: Inventor CEO Indicator & M&A announcement return					
	All M&A	Private Target	Non-Private target	Private & Innovative Target	Non-Private or Non-innovative target
Inventor CEO Indicator	0.011***	0.018**	-0.004	0.033**	0.004
	(2.934)	(2.488)	(-0.436)	(2.087)	(0.712)
Year * Industry (AC) FE	Y	Y	Y	Y	Y
Baseline Control variables	Y	Y	Y	Y	Y
Deal level Control variables	Y	Y	Y	Y	Y
Observations	1,563	830	733	271	1,291
Adjusted R-squared	0.105	0.140	0.189	0.266	0.104
Panel B: Innovation-Active CEO Indicator & M&A announcement return					
Innovation-Active CEOs	0.022***	0.026**	0.016	0.054***	0.016*

	(3.139)	(2.417)	(1.012)	(2.920)	(1.667)
Year * Industry (AC) FE	Y	Y	Y	Y	Y
Baseline Control variables	Y	Y	Y	Y	Y
Deal level Control variables	Y	Y	Y	Y	Y
Observations	1,563	830	733	271	1,291
Adjusted R-squared	0.107	0.141	0.191	0.278	0.105
Panel C: High impact and Low impact innovation experience & M&A announcement return					
High impact innovation experience	0.013	0.023*	-0.014	0.048**	0.002
	(1.638)	(1.874)	(-0.934)	(2.307)	(0.199)
Low impact innovation experience	0.010**	0.015**	0.002	0.025	0.005
	(2.073)	(2.129)	(0.200)	(1.435)	(0.933)
Year * Industry (AC) FE	Y	Y	Y	Y	Y
Baseline Control variables	Y	Y	Y	Y	Y
Deal level Control variables	Y	Y	Y	Y	Y
Observations	1,563	830	733	271	1,291
Adjusted R-squared	0.105	0.140	0.191	0.270	0.104

Table 14. Value Creation from New Product Announcement

The table presents results of incremental value creation from new product announcements by the Inventor-CEOs. *Inventor CEO* is equal to one if the CEO has at least one patent issued in her own name from US Patent and Trademark office (USPTO). *Innovation Active-CEOs* is equal to one if the CEO has at least one patent issued in her own name around 2 years of focal firm year from US Patent and Trademark office (USPTO). *High-Impact Innovation experience* is equal to 1 if the number of patents registered with the CEO as one of the assignees that accumulates above median number of patents-class-year adjusted citations is more than 2 (which is the median of the distribution of such impactful innovation by all the inventor CEOs) and is 0 otherwise. *Low-Impact Innovation experience* is equal to 1 if the number of patents registered with the CEO as one of the assignees that accumulates above median number of patents-class-year adjusted citations is less than or equal to 2 and is 0 otherwise. *New Product announcement return* is defined as the sum of all positive cumulative abnormal returns over the year in basis points and *Major New Product Announcement* is the number of announcements with cumulative abnormal returns above the 75th percentile following Mukherjee et al. (2016). *Tobin's Q* is defined as (book value of assets-book value of equity +market value of equity) /book value of assets. *Firm Size* is the natural log of book value of Asset of the firm. *Firm-age* is the Log of firm age where firm age is the number of years since the inception of the firms. Volatility is the volatility of stock return. *CAPEX* is Capital expenditure scaled by Asset. Missing values are coded with zero. *R&D/Asset* is Research and development expenditures scaled by total assets. Missing values are coded with zero. *Leverage* is defined as (long-term debt+ Short-term debt) /Total assets. CEO-Tenure is the CEO tenure in years. *PhD (STEM)* is an indicator variable equal to one for CEOs with PhD in Science, Technology, Engineering and Mathematics and zero otherwise. *Technical Education* is an indicator variable equal to one for CEOs with undergraduate or graduate degrees in engineering, physics, operation research, chemistry, mathematics, biology, pharmacy, or other applied science and zero otherwise. *MBA* is an indicator variable equal to one if the CEO received MBA degree or zero otherwise. No school information is an indicator equal to one if we cannot identify the CEOs' undergraduate school and zero otherwise. All regressions include year and industry (based on two digit SIC code) fixed effects. Standard errors are clustered at the firm level. *t*- ratios are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Variables	Full sample			Excluding Innovation active CEOs	Full sample			Excluding Innovation active CEOs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	New Product announcement return				Log(1+# Major New Product Announcement)			
Inventor CEOs (Indicator)	0.198**				0.295***			
	(2.352)				(2.887)			
Innovation-Active CEOs		0.212**				0.357***		
		(2.532)				(3.212)		
High impact innovation experience			0.164***	0.109**			0.350***	0.294**

			(2.760)	(1.982)			(3.003)	(2.061)
Low impact innovation experience			0.221*	0.188			0.258**	0.230*
			(1.969)	(1.588)			(2.060)	(1.729)
Firm-size	0.132***	0.132***	0.131***	0.120***	0.289***	0.290***	0.290***	0.279***
	(4.817)	(4.585)	(4.950)	(4.474)	(8.168)	(7.889)	(8.222)	(7.662)
Firm Age	-0.020	-0.019	-0.021	-0.012	-0.051	-0.047	-0.050	-0.041
	(-0.915)	(-0.854)	(-0.953)	(-0.687)	(-1.136)	(-1.062)	(-1.115)	(-0.914)
Volatility	0.001	0.004	-0.000	-0.012	0.026	0.032	0.029	0.028
	(0.065)	(0.229)	(-0.027)	(-0.648)	(0.620)	(0.730)	(0.700)	(0.672)
RD/Assets	0.802***	0.766***	0.805***	0.788***	2.307***	2.248***	2.301***	2.347***
	(4.058)	(3.990)	(4.050)	(4.083)	(4.581)	(4.558)	(4.576)	(4.528)
CAPEX	-0.074	-0.115	-0.084	-0.250	0.257	0.170	0.272	0.069
	(-0.163)	(-0.256)	(-0.181)	(-0.583)	(0.326)	(0.219)	(0.344)	(0.084)
Leverage	-0.446***	-0.447***	-0.446***	-0.394***	-0.927***	-0.927***	-0.927***	-0.798***
	(-3.473)	(-3.319)	(-3.493)	(-3.108)	(-4.215)	(-4.179)	(-4.202)	(-3.427)
Log(Tobin's Q)	0.061*	0.057	0.061*	0.063*	0.110**	0.103**	0.109**	0.120**
	(1.696)	(1.513)	(1.683)	(1.772)	(2.268)	(2.064)	(2.230)	(2.415)
CEO Tenure	0.000	0.001	0.000	-0.000	0.000	0.001	-0.000	-0.001
	(0.116)	(0.391)	(0.160)	(-0.147)	(0.034)	(0.172)	(-0.013)	(-0.391)
PhD (STEM)	-0.059	-0.032	-0.054	-0.026	-0.015	0.020	-0.024	-0.029
	(-0.819)	(-0.530)	(-0.776)	(-0.346)	(-0.133)	(0.193)	(-0.202)	(-0.229)
Technical Education	0.027	0.024	0.028	0.035	0.013	0.007	0.011	0.022
	(0.739)	(0.630)	(0.768)	(1.148)	(0.194)	(0.111)	(0.165)	(0.337)
MBA	0.013	0.006	0.010	0.020	0.083	0.074	0.086	0.087
	(0.412)	(0.188)	(0.338)	(0.718)	(1.381)	(1.226)	(1.445)	(1.451)
No school information	0.066	0.062	0.065	0.078*	0.080	0.074	0.081	0.105
	(1.347)	(1.194)	(1.358)	(1.695)	(0.760)	(0.674)	(0.771)	(0.971)
Constant	-0.977***	-0.970***	-0.972***	-0.914***	-1.832***	-1.822***	-1.841***	-1.812***

	(-3.949)	(-3.772)	(-4.043)	(-3.854)	(-4.602)	(-4.533)	(-4.640)	(-4.504)
Observations	1,438	1,438	1,438	1,348	1,438	1,438	1,438	1,348
Adjusted R-squared	0.338	0.328	0.339	0.333	0.364	0.363	0.365	0.348
Industry-Fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y

Appendix

Inventor CEO Dataset

In this section, we describe the process of Inventor CEO dummy construction by matching the US Patent Inventor Database (PID) from Li et al. (2014) to ExecuComp list of CEOs in our sample of High-tech firms during 1992-2008. PID contains information (name, Country, State, City etc.) on each of the patentee of more than 8 million inventor-patents instances for patents filed since 1901 through 2010 at USPTO. It also contains data on patent Assignees. More importantly, it contains unique inventor ID and unique assignee ID for all these patents.

Step 1: We use regular expression to standardize the names of the CEOs in ExecuComp dataset to generate a list of unique CEO names with first, middle and last names. The names of Inventor in PID are already in Standardized form. In PID, 'Full name' defined as having both first and last name present is available for 99.99% of records.

Step 2: We then match unique CEO names (Last names, Middle names and First names) in ExecuComp to Patentee names (Last names, Middle names and First names) in PID and generate a list of probable matches. We retain information on Unique Inventor ID in this list which we use later to recover all the patents that belong to a particular patentee from PID.

Step 3: Since we have Company names and Assignee names from this matching process, we identify instances where we find matches for both CEO names and Company names from ExecuComp to Patentee names and Assignee names in PID, respectively. If we find matches in both individual name category (CEO name and Patentee name) and organizational name category (Company name and Assignee), we code them as 1 for Inventor CEO Indicator variable.

Step 4: Next, we identify rest of the instances in this list where we CEO names and Patentee names are matched; however Company names and Assignee names do not match from this list. For example, we find match for Gilberto F. Amelio who was a CEO for National Semiconductor Corp (1992-1995) and Apple Inc. (1996-1997) in our sample. However, this list shows 'Fairchild Camera And Instrument Corporation' as the Assignee for all patents applied from 1973 through 1977 by this patentee.

Step 5: Since we collect biographies for all the CEOs in our sample (various sources including Funding Universe website, Notable Names Data Base (NNDB), company websites, and other Internet resources including Wikipedia, Forbes pages, Bloomberg's Business Week website, LinkedIn pages, Crunchbase.com, among others), for matches in step 4, we track their career history and confirm whether they have worked for these Assignee companies/organizations in the past. Therefore, in step 3 and step 5, we identify inventor CEOs (regardless of the focal firms in our sample) who have patenting history in USPTO. To continue with the previous example of Gilberto F. Amelio, we track his career history and find that he had worked for Fairchild Camera and Instrument Corporation during 1971-1983.[15] The detailed executive profile also mentions that he holds several patents.[16]

[15] (https://www.bloomberg.com/profiles/people/1409980-gilbert-f-amelio)

[16] http://www.bloomberg.com/research/stocks/people/person.asp?personId=72492&privcapId=30820843

Table A1. Variable definition

Patents (t+1)	Log(1+# of patents) at t+1
Patents (t+2)	Log(1+# of patents) at t+2
Citation(t+1)	Log(1+# of Citations) at t+1
Citations (t+2)	Log(1+# of Citations) at t+2
Radical Innovation	Patents that have cited the maximum number of times in an industry-year pair
Firm Size	Log(Total Assets)
RD/Assets	The ratio of research and development expenditures over total assets, expressed as a percentage. Missing values are set to zero
CAPEX	The ratio of Capital Expenditure over total assets, expressed as a percentage. Missing values are set to zero
Firm Age	Natural logarithm of the number of years since the firm's inception
Leverage	Sum of Short term debt and Long-term debt scaled by Total Assets
Tobin's Q	The market value of assets divided by the book value of assets where the market value of assets equals the book value of assets plus the market value of common equity less the sum of the book value of common equity and balance sheet deferred taxes
CEO Tenure	CEO tenure in years
Volatility	Volatility of stock return
Founder-CEO	Founder CEO is equal to one if the CEO is a founder of the firm or CEO since the founding year of the firm
Overconfident CEO (67)	*Overconfident CEO (67)* is an indicator variable equal to one for all years after the CEO's options exceed 67% moneyness and zero otherwise.
Board size	Number of directors in the Corporate Board
Co-option	Co-option is the fraction of directors those are appointed after CEO assumed office as defined in Coles et al. (2014).
Institutional Holdings (%)	Percentage of shares held by financial institutions
CEO ownership	CEO ownership is defined as the ratio of the number of shares owned by the CEO after adjusting for stock splits to total shares outstanding.
CEO Equity-based pay	CEO equity-based pay is the value of annual option pay divided by the sum of salary, bonus and annual option pay

Delta	Dollar change in CEO stock and option portfolio for a 1% change in stock price.
Vega	Dollar change in CEO option holdings for a 1% change in stock return volatility.
PhD STEM	*PhD (STEM)* is an indicator variable equal to one for CEOs with PhD in Science, Technology, Engineering and Mathematics and zero otherwise.
Technical Education	*Technical Education* is an indicator variable equal to one for CEOs with undergraduate or graduate degrees in engineering, physics, operation research, chemistry, mathematics, biology, pharmacy, or other applied science and zero otherwise.
MBA	*MBA* is an indicator variable equal to one if the CEO received MBA degree or zero otherwise.
No School Information	No school information is an indicator equal to one if we cannot identify the CEOs' undergraduate school and zero otherwise.
New Product announcement return	*New Product announcement return* is defined as the sum of all positive cumulative abnormal returns over the year (Mukherjee et al. (2016))
Major New Product Announcement	is the number of announcements with cumulative abnormal returns above the 75 percentile (Mukherjee et al. (2016))