Received: 24 May 2021 | Revised: 13 May 2024 | Accepted: 16 May 2024

DOI: 10.1002/smj.3628

RESEARCH ARTICLE

SMS | Strategic Management Journal WILEY

# Inventor CEO involvement and firm exploitative and exploratory innovation

**Joseph S. Harrison**[1] | **Steven Boivie**[2] | **Ithai Stern**[3] | **Joseph Porac**[4]

[1]Department of Management and Entrepreneurship, Haslam College of Business, University of Tennessee, Knoxville, Tennessee, USA

[2]Department of Management, Mays Business School, Texas A&M University, College Station, Texas, USA

[3]INSEAD, Boulevard de Constance, Fontainebleau Cedex, France

[4]Department of Management and Organizations, Stern School of Business, New York University, Summit, New Jersey, USA

**Correspondence**
Joseph S. Harrison, Department of Management and Entrepreneurship, Haslam College of Business, University of Tennessee, 453 Haslam Business Building, Knoxville, TN 37996, USA.
Email: jsharrison@utk.edu

## Abstract

**Research Summary:** This study extends recent findings that inventor CEOs increase innovative output in large established firms by examining how their involvement in the innovative process influences the nature of innovations produced. Our theory suggests that inventor CEOs who take a hands-on approach to innovation lead their firms to engage in more exploitative rather than exploratory innovation. We further posit that this effect is particularly strong for insider inventor CEOs, and especially founders, but weaker for outsiders and when the firm's board has broader industry experience. Using a sample of S&P 1500 firms from 1994 to 2010 and inventor CEOs' engagement in patenting as an indicator of hands-on involvement, we find considerable support for our predictions.

**Managerial Summary:** CEOs with hands-on experience innovating can substantially increase innovative output in large established firms. Yet, we show that inventors who remain directly engaged in their firms' innovation activities as CEO can limit their scope to incremental innovations that exploit existing technologies as opposed to more radical innovations that result

  

in novel product or service offerings. These tendencies are stronger for inventors who come to the CEO position from inside the firm, especially founders, but weaker when the firm's board has broader industry experience. Overall, our study reveals an important tradeoff for large firms of having an inventor as CEO, how hands-on involvement by inventor CEOs may narrow their firms' innovative trajectories, and how or when these tendencies can be mitigated.

**KEYWORDS**

board industry diversity, CEO origin, exploitative and exploratory innovation, founder CEOs, inventor CEOs

## 1 | INTRODUCTION

Recent studies highlight that large established firms can gain considerable benefits from having CEOs with hands-on innovation experience (Byun et al., 2021; Islam & Zein, 2020; van de Wal et al., 2020). Referred to as "inventor CEOs," these individuals are argued to possess superior skills in evaluating, selecting, and executing innovative projects, enabling their firms to carry out more and higher-quality innovation activities (Islam & Zein, 2020; van de Wal et al., 2020). Although this argument has merit, inventor CEOs' involvement and influence on innovation is likely more complex than the associated research would suggest.

Whereas all inventor CEOs by definition have prior hands-on experience innovating, we reason that differences exist in whether they take a direct, hands-on approach to innovation after becoming CEO versus offering higher-level and more indirect oversight. Such differences may be especially evident in large established firms. Unlike small entrepreneurial firms, where CEOs' direct engagement in their firms' day-to-day innovation activities may be self-evident (Miller, 1983; Runst & Thomä, 2022), the complex organizational structures and multiple managerial layers that typify large established firms raise questions about the extent and effect of CEO involvement in those firms' innovative activities. Anecdotal evidence from the business press and executive biographies help to illustrate the variability in individual inventor CEOs' levels of involvement. On the one hand, inventor CEOs like Paramesh Gopi of Applied Micro Circuits (Gopi, 2013) and Laura Alber of Williams Sonoma (Alber, 2014) seem to take a high-level approach by championing an innovative focus but granting their research teams autonomy and giving them credit for innovations produced by their firms. On the other hand, individuals like Steve Jobs of Apple (Markoff, 2011) and George Lopez of ICU Medical (Davis, 2018) have been credited for directly contributing to the development of their firms' products and technologies, suggesting a more hands-on approach.

Our premise in this study is that when inventor CEOs take a hands-on approach to innovation, certain cognitive and structural constraints associated with taking such an approach in large established firms will lead them to steer those activities toward incremental innovations that exploit existing technologies (i.e., exploitative innovation) as opposed to more radical innovations that extend beyond the firm's existing knowledge base and result in novel product or

service offerings (i.e., exploratory innovation) (Lavie et al., 2010). Substantial research suggests that firms must balance between exploitative and exploratory innovation to achieve sustainable competitive advantage and profitability (Andriopoulos & Lewis, 2009; He & Wong, 2004; Lavie et al., 2010). Overemphasis on exploitative innovation can lead to stagnation and obsolescence, while overemphasis on exploration may prevent firms from effectively monetizing their innovative ideas (Mudambi & Swift, 2014). Thus, merely increasing innovation without balancing between exploitation and exploration can be extremely detrimental to firms. Understanding how inventor CEOs' involvement in innovation activities affects this balance is therefore of critical importance, especially given the rise of inventors among CEOs of large established firms. Based on recent studies and data we collected, inventors account for roughly 10% of Standard & Poor's (S&P) 1500 CEOs, 20% for the subset of high technology and research and development (R&D) intensive firms, and these values have been increasing over time (Islam & Zein, 2020; van de Wal et al., 2020). As more inventors rise to the CEO level in these firms, it becomes more important to understand their potential influence on the nature, and not just the amount, of innovations their firms produce.

We contribute to this understanding by developing and testing theory to explain why firms of inventor CEOs who take a hands-on approach to innovation might tend to produce more exploitative and less exploratory innovations than those led by inventor CEOs who take a more hands-off approach. Integrating the literatures on executive job demands, R&D team structures, and innovative search and deployment, we argue that these tendencies will stem from two main processes. First, they will arise as more involved inventor CEOs narrow their focus to cope with the distinct cognitive demands of engaging directly in innovation activities while simultaneously trying to manage the complex responsibilities of the CEO role in large firms (Zhu et al., 2022). Second, they will stem from inventor CEOs' residual influence on the structure and behavior of their R&D teams when engaging directly with those personnel, via signaling the desired innovative trajectory, reducing autonomy, and increasing pressure for quick innovative results (Simsek, 2007; Xu et al., 2022). We show evidence for these effects in a sample of S&P 1500 firms over a 15-year period, using inventor CEOs' ongoing authorship on firm patents as an indicator of hands-on involvement. We then expand on these arguments and findings by considering how the relationship between hands-on involvement and firm exploitative (exploratory) innovation may vary depending on other characteristics of firms' leaders that are likely to further play into our theorized mechanisms. Specifically, drawing on research that has identified CEO origin and board diversity as critical antecedents of firm innovation outcomes (Kurzhals et al., 2020; Simsek et al., 2013), we argue and find that the positive relationship between inventor CEO hands-on involvement and exploitative innovation is stronger for insider inventor CEOs, especially founders, but that being an outsider and having a board with broader industry experience can attenuate this effect.

Our theory and findings challenge and extend prior views on inventor CEOs and firm innovation. Whereas existing research has essentially portrayed inventor CEOs as universally beneficial for firms' innovative output (Islam & Zein, 2020; van de Wal et al., 2020), we argue and find that their influence is significantly more complex than that. Specifically, we show that the exploitative versus exploratory nature of innovations produced by inventor-led firms depends on inventor CEOs' approach to managing innovation, their origin, and the experience of the board. This represents a more contextualized view of inventor CEOs' effects that is not only important for individual firms, given the implications of firm exploitative and exploratory innovation for their ability to sustain competitiveness (Lavie et al., 2010), but also for society at

large, because broader technological development and economic growth often depend on the nature of innovations coming out of private companies (Snyder, 2019; Waikar, 2019).

## 2 | THEORETICAL BACKGROUND

### 2.1 | CEO characteristics and corporate innovation

Innovation is essential for firms to develop and sustain a competitive advantage and to achieve positive performance over the long term. Yet, given the strong inertial forces that often exist in large established firms, achieving innovative outcomes in those firms can be particularly difficult (Christensen, 1997; Kanter, 1985). Research suggests that overcoming these barriers requires a champion at the top of the organization who not only will attend to innovative opportunities, but who also will support and promote their pursuit (Clark & Wheelwright, 1992; Howell & Higgins, 1990). Along these lines, a broad literature has emerged to explore how characteristics of CEOs, as firms' primary decision makers and attention regulators, influence corporate innovation (see Kurzhals et al., 2020).

Among the most consistent findings in this literature are that innovation rates tend to be lower in firms of older and longer-tenured CEOs, while firms led by younger, shorter-tenured CEOs and those with broader managerial experience or backgrounds in output functions tend to engage in more innovation (Barker & Mueller, 2002; Daellenbach et al., 1999). Additional research suggests that innovation is enhanced by certain cognitive tendencies of CEOs, including their future orientation and attention to novel technologies or product development processes (Eggers & Kaplan, 2008; Nadkarni & Chen, 2014). Similar effects have also been found for CEOs' dispositional attributes, like overconfidence (Galasso & Simcoe, 2011) and narcissism (Gerstner et al., 2013). Overall, these studies collectively emphasize that CEOs' personal attributes, experiences, and dispositions can have a tangible impact on firm innovativeness by influencing their risk appetites and preferences, as well as their attention and tendency to support innovation (Kurzhals et al., 2020).

### 2.2 | Inventor CEOs and corporate innovation

More recently, research has gone beyond CEOs' general characteristics and backgrounds to consider how their specialized technical experience might influence firm innovation (Islam & Zein, 2020; van de Wal et al., 2020). This work has specifically explored the impact of so-called "inventor CEOs," or those with hands-on experience developing new technologies, processes, or products. Scholars have argued that such direct experience with the innovation process can have important implications that go beyond simply being a champion of innovation. Given their prior hands-on experience, inventor CEOs may not just prioritize and invest more in innovation than non-inventors, but they also may have a superior ability to evaluate innovative opportunities and understand how to translate ideas into tangible, scalable inventions (Islam & Zein, 2020).

Existing empirical evidence seems to support this view. It has shown that, relative to firms of non-inventors, those managed by inventor CEOs tend to invest more heavily in R&D, produce more and higher quality patents, and are better at converting patents into tangible products and services (Byun et al., 2021; Islam & Zein, 2020; Lin et al., 2021; van de Wal

et al., 2020). Despite the insights this work has provided into inventor CEOs' influence on firm innovation, it has generally tended to focus on innovation rates or quality without considering the exploitative or exploratory nature of innovations produced by their firms (Andriopoulos & Lewis, 2009; Lavie et al., 2010).[1] This is a critical oversight, given the considerable strategic consequences of firms' exploitative or exploratory approach to innovation.

### 2.3 | Exploitative versus exploratory innovation

The distinction between exploitation and exploration harkens back to March (1991) and has been established in the literature as distinguishing two disparate approaches to corporate innovation (e.g., Danneels, 2002; Jansen et al., 2006). Whereas an exploitative approach takes advantage of firms' existing knowledge and capabilities to provide incremental innovations, an exploratory approach involves broader search beyond firms' existing knowledge base and the pursuit of novel resource combinations that produce more profound innovations. Exploration thus involves "a pursuit of new knowledge," while exploitation involves "the use and development of things already known" (Levinthal & March, 1993, p. 105).

Thus defined, exploitative and exploratory innovation represent fundamentally different approaches to innovation with different implications for firm competitiveness. Given exploitative innovation involves small improvements to a firm's existing technologies, it is often less risky and tends to produce more consistent short-term gains, but sometimes at the expense of long-term competitiveness (Lavie et al., 2010; March, 1991). Conversely, exploratory innovation often involves a greater amount of risk that creates performance variability in the near term but has the potential to fundamentally alter the positioning of firms and even industries in the long term (Carson et al., 2022; March, 1991; Withers et al., 2018). And while firms may sometimes seek a combination of these strategies (Tushman & O'Reilly, 1996), inconsistencies between the capabilities and cognitive frames required for exploitative and exploratory innovation make their simultaneous pursuit a challenging proposition (Andriopoulos & Lewis, 2009; Benner & Tushman, 2015; Lavie et al., 2010; Uotila et al., 2009). In turn, it is important to understand how inventor CEOs might influence the balance between exploitative and exploratory innovation in large established firms.

## 3 | HYPOTHESES DEVELOPMENT

### 3.1 | Inventor CEO involvement and firm exploitative (exploratory) innovation

Our central thesis is that individual inventor CEOs' effects on their firms' innovative trajectories will hinge on their level of involvement in firm innovation activities. By definition, all inventor CEOs have some hands-on experience with the innovation process prior to becoming CEO

[1]We note that Islam and Zein (2020) explored the relationship between inventor CEOs and what they referred to as "radical innovation"; however, their measure of radicality simply reflected whether the firm had one or more patents cited in the 99th (or 90th) percentile of patents filed in the same technology class that year. Thus, while "exploration" and "radicality" are often viewed similarly, their measure of radicality is more reflective of "impact" and does not align with the more traditional view of exploration that we highlight next, as pursuing innovation in novel areas.

(Byun et al., 2021; Islam & Zein, 2020; van de Wal et al., 2020). But variance exists in their level of continued involvement in firm innovation while serving in the CEO role, especially in large established firms. Whereas some take a hands-off approach by simply allocating capital to innovation activities or setting broad, firm-level innovation policies, others might take a more hands-on approach by remaining directly engaged in the innovation process, meeting directly with R&D personnel, and directly contributing ideas and effort to specific innovations. In general, we posit that large established firms led by hands-on inventor CEOs will tend to produce more exploitative and less exploratory innovations than firms of more hands-off inventor CEOs.[2]

There are two main reasons for this argument. The first involves forces associated with the CEO role in large established firms and the cognitive demands of trying to simultaneously manage the organization while contributing directly to firm innovation (Zhu et al., 2022). The CEO position in large firms, especially public firms, involves a broad range of responsibilities, such as formulating firm strategy, overseeing operations, interacting with market intermediaries, and managing firm resources (Busenbark et al., 2016). If an inventor CEO also remains directly involved in the firm's innovation activities, it suggests the individual is attempting to lead by assuming a share of the technical detail in those activities and by paying close attention to the technical work of subordinates (Slusher et al., 1972). But inventor CEOs who attempt to engage in this way will be stretching their ability to stay competent in their multiple roles (Dahlander et al., 2016; Katila et al., 2017). These dynamics will also be strongest when considering the potential pursuit of exploratory innovation at the boundary of knowledge, which is associated with high levels of uncertainty and requires significant time and effort for search, experimentation, and learning (Alvarez & Porac, 2020; March, 1991).

To manage these demands, hands-on inventor CEOs are likely to narrow their focus to innovations that involve fewer technological uncertainties and that are directed toward shorter-term technological exploitation. Consistent with this view, Zhu et al. (2022) recently found that high executive job demands tend to shift the balance of firm-level innovation activities toward exploitative innovation and away from exploratory innovation. Regardless of an inventor CEO's openness to novel technologies, the inherent challenges of directly contributing to firms' innovation activities while also fulfilling their managerial responsibilities is likely to lead hands-on inventor CEOs toward innovation that leverages their firms' existing technologies. Such innovation will be top-of-mind for a CEO who is directly engaged in firm innovation and will not require as much time or cognitive effort for search compared to more novel innovations. In contrast, inventor CEOs who are less involved in the innovative process would not experience these same pressures, freeing them up to take a broader and more inclusive approach to innovation while delegating the effortful search and development of novel or emerging technologies to others in their organization.

A second and related reason that inventor CEOs' hands-on involvement will lead to more exploitative and less exploratory innovation in large firms has to do with the residual effects their direct involvement will have on other members of the organization who are responsible

[2]Where we use the terms "hands-on (hands-off) inventor CEOs," we do so simply for conciseness, rather than referring to "inventor CEOs who take a hands-on (hands-off) approach" each time we reference these disparate approaches. These terms are not meant to indicate perfectly stable tendencies or traits. A given inventor CEO may be more or less directly involved in firm innovation at different points in their career. But based on our sample, we believe such variance is likely to be minimal and would not affect our theoretical arguments. We also account for this variance directly in our measure of involvement, which demonstrates general stability but is allowed to vary over time. We provide relevant details about the measure in the methods section.

for firm innovation, which may manifest in a number of ways. To begin with, the CEO's actions are the most salient representation of organizational expectations for appropriate behaviors and their desired outcomes (Love et al., 2017). Employees tend to generalize their perception of the CEO to the organization at large, and they respond to these expectations by regulating their own behavior and choices to synchronize with their CEO's proclivities (Livingston, 2003; Scott & Bruce, 1994). Along these lines, Simsek (2007) argued that the risk propensities of the executive team are shaped by the risk-taking behavior that the CEO brings to the tasks of evaluating, rewarding, and motivating them. Supporting this argument, he found that CEO tenure indirectly influences performance through its effects on the risk-taking propensity of the executive team and the firm's pursuit of entrepreneurial initiatives. These same influences should also operate at lower organizational levels as hands-on inventor CEOs directly interact with R&D personnel deep inside their organizations. When an inventor CEO takes a hands-on approach to innovation, R&D personnel are likely to observe the CEO's behavior and use it as a signal for the technology they should develop and the type of innovation they are expected to pursue. Given our prior arguments regarding the exploitative tendencies of hands-on inventor CEOs, this in turn will lead to narrower innovation search by other R&D personnel along the signaled exploitative technological trajectory (cf. Li et al., 2013).

Besides serving as a signal, an inventor CEO's hands-on involvement may also limit intellectual heterogeneity because of the implications it will have for power structures and autonomy levels within the R&D team. By their nature, R&D teams where the CEO actively participates will be structured more hierarchically than those of more hands-off inventor CEOs, and prior evidence shows that hierarchal team structures decrease creativity in scientific teams (Xu et al., 2022). Similarly, management research has long stressed the importance of granting R&D personnel a high degree of autonomy, freedom, and support to function independently in the pursuit of new ideas (Kanter, 1983; Miller, 1986; Siegel & Kaemmerer, 1978). Autonomy is particularly important for achieving high levels of exploration (Boumgarden et al., 2012; McGrath, 2001). But because an inventor CEO's presence will create a power imbalance within the R&D team, R&D personnel are likely to perceive a lower sense of autonomy when the CEO directly engages in innovation activities.

Moreover, the presence of an inventor CEO at the helm of R&D initiatives inherently intensifies pressure for R&D personnel to be producing tangible outputs. Such output pressure likely compels team members to lean toward exploitation strategies over exploration, as these are typically associated with quicker, more tangible results and a higher probability of success. Consequently, when an inventor CEO directly engages in firm innovation activities, this will further hamper the creativity and autonomy of the R&D team, leading to more exploitative innovation and less exploratory innovation compared to when an inventor CEO takes a less direct approach to innovation (Boumgarden et al., 2012; McGrath, 2001). Conversely, because less direct oversight would support greater autonomy and reduce pressure for quick, tangible results, the R&D team is likely to pursue more exploratory innovation when an inventor CEO takes a more hands-off approach to innovation.

Altogether, given the natural constraints inventor CEOs face when attempting to engage directly in innovation while simultaneously managing their other responsibilities, as well as the residual influence their involvement will have on R&D personnel, we propose the following:

> **Hypothesis 1.** An inventor CEO's hands-on involvement in innovation activities will be positively associated with exploitative innovation and negatively associated with exploratory innovation produced by the firm.

### 3.2 | The moderating role of CEO origin

Whereas inventor CEOs' hands-on involvement should generally be associated with more exploitative and less exploratory innovation, the strength of this relationship may vary depending on whether the inventor was internally promoted or externally hired into the CEO position (Simsek et al., 2013; Wang & Zatzick, 2019). Specifically, we posit that the relationship is more pronounced for internally promoted inventor CEOs than their externally appointed counterparts, for several reasons. In the first place, the promotion of an insider as CEO signals a commitment to continuity and stability and that the board of directors has confidence in the leadership and direction of the firm (Quigley et al., 2019). Indeed, research on CEO succession has shown that insiders tend to be hired when performance is healthy, the ongoing strategy appears viable, and the board seeks continuity, while outsiders are more frequently hired when performance is poor and the board seeks change (Shen & Cannella, 2002). In our setting, this means that the selection of an insider inventor as the CEO will likely be interpreted as a vote of confidence in the firm's technological trajectory and approach to innovation, whereas outsiders are more likely to be appointed with a specific mandate for change and experimentation (Simsek et al., 2013; Zhang & Rajagopalan, 2010). Thus, as hands-on inventor CEOs attempt to deal with the time and cognitive demands associated with fulfilling their multiple roles, they will have an even more direct motivation to focus on their firms' existing technologies when they are promoted from within the firm relative to when they are appointed from outside the firm.

Hands-on inventor CEOs who are selected from inside the firm are also likely to be more geared toward incremental innovations than outsiders because of their intimate knowledge of their firms' existing technologies and their organization-specific human and social capital (Zollo & Winter, 2002). Having been promoted from within the ranks of the firm, insiders are likely to have developed skills and expertise near the firm's technological domain (Cummings & Knott, 2018). Thus, insiders' competence and confidence with the firm's core technologies will make it more natural for them to refine and extend those technologies as they directly engage in innovation, rather than experimenting with new ones (March, 1991). In contrast, outsider inventor CEOs will be less familiar with the firm's internal technological competencies and more likely to bring novel ideas from outside the firm when engaging directly in firm innovation.

This tendency may be further reinforced by hands-on inventor CEOs' networks and social capital, which would be more deeply embedded inside the firm for insiders relative to outsiders (Paruchuri & Awate, 2017; Reagans & Zuckerman, 2001). Innovation results from the recombination of knowledge that inventors access through collaboration networks (Cowan et al., 2007; Singh et al., 2016). Such knowledge resides both within and outside the firm (Grigoriou & Rothaermel, 2017), and inventors' abilities to access knowledge depends on their location in the intra- and inter-firm inventor network (Paruchuri, 2010). Inventor CEOs who have ascended from within the firm are inherently more ingrained within the intra-firm network compared to their externally recruited counterparts. As a result, when taking an active, hands-on role in their firms' innovation activities, insider inventor CEOs will draw heavily on their established knowledge domain and intra-firm inventor network, rather than push the firm into unexplored technological territories, as may be more likely for hands-on outsider inventor CEOs.

Just as inventor CEOs' mandates, knowledge, and networks affect their own focus and tendencies toward exploitative innovation, so also will they influence the behavior of their R&D teams. Again, when inventor CEOs engage directly with R&D personnel, their approach will

serve as a strong signal for the technology those individuals are expected to pursue (Livingston, 2003; Scott & Bruce, 1994). If an inventor CEO's focus is more clearly on incremental innovation when engaging with the R&D team, as it likely would be for inventors promoted from within the firm, this will provide a stronger signal and increase other R&D personnel's likelihood of pursuing similarly incremental innovations. In contrast, externally appointed inventor CEOs may bring a different set of priorities, perspectives, and technological knowledge, and their lack of familiarity with the internal dynamics and traditions of the firm could encourage a departure from the status quo (Quigley et al., 2019; Shen & Cannella, 2002). When these individuals interact with R&D personnel, their broader orientation may signal a preference for recombinative technologies, unconventional approaches, and a willingness to take risks. This can create an environment that fosters a culture of exploratory innovation within R&D teams, granting them a certain degree of autonomy to think beyond incremental improvements and explore novel ideas (Kanter, 1983; Miller, 1986). Accordingly, we posit:

> **Hypothesis 2.** The positive (negative) association between an inventor CEO's hands-on involvement in innovation activities and firm exploitative (exploratory) innovation will be stronger for insiders and weaker for outsiders.

Taking these arguments a step further, a specific type of insider that is particularly relevant in our case is being a founder. Prior research and examples of inventor CEOs indicate that about half of them obtain the CEO position by founding their own firms to commercialize the technologies they created. Notable examples include Thomas Edison founding what is now General Electric to market the incandescent lamp, Bill Gates and Paul Allen founding Microsoft based on the BASIC implementation they developed for the Altair microcomputer, and Martine Rothblatt founding United Therapeutics to develop a cure for her daughter's pulmonary hypertension. As inventor founders remain directly engaged in innovation activities, they are especially likely to encourage an emphasis on exploitative innovation both because of their particular familiarity with the technologies they developed and because of the outsized power and influence they wield in their firms (Cannella & Holcomb, 2005; Haveman, 1993).

Prior research suggests that founders have a strong sense of ownership and connection to their firms and the technologies upon which those firms were built (Cardon et al., 2005). As the individuals who started the business and nurtured its growth, founders have an emotional connection to the firm, often referring to it as their "baby" or "legacy" (Graebner & Eisenhardt, 2004). Founders also exhibit an "extreme bias toward optimism" (Cooper et al., 1988, p. 106) and have upwardly biased opinions of their firms' strengths and associated prospects for long-term success (Busenitz & Barney, 1997; Certo et al., 2001). These robust positive convictions, we argue, will lead inventor-founder-CEOs to persist in believing and investing in the firm's foundational technology.

To the extent that these individuals remain directly involved in the innovation activities, they are even more likely than other insiders to emphasize the firm's existing technologies and they will send even stronger signals to their R&D teams that such exploitation is the desired and expected trajectory of the firm. These dynamics will be further reinforced because founders who maintain the CEO position have substantial professional authority and political influence within their firms (Cannella & Holcomb, 2005; Haveman, 1993). Given their authoritative dominance and political sway, inventor founders' hands-on involvement will have a particularly strong negative impact on R&D personnel's sense of autonomy and creativity (Hendricks et al., 2019; Mainemelis et al., 2015). This is likely to diminish R&D personnel's inclination to

propose and spearhead breakthrough technologies, thus leading to an even stronger emphasis on exploitative innovation over exploratory innovation, even relative to other insider inventor CEOs. Formally:

> **Hypothesis 3.** The positive (negative) association between an inventor CEO's hands-on involvement in innovation activities and firm exploitative (exploratory) innovation will be strongest for founders.

## 3.3 | The moderating role of board industry diversity

The background of the firm's board can also play an important role in contextualizing inventor CEOs' influence on their firms' innovative trajectories. As we have argued, the exploitative tendencies of hands-on inventor CEOs are likely not intentional; rather, they arise from natural constraints of directly contributing to innovation while balancing the other demands of the CEO role in large firms. These constraints are likely to lead hands-on inventor CEOs to narrow their focus on the technologies and knowledge networks that are immediately accessible to them, which will also have a residual influence on other, lower-level R&D personnel. But as key collaborators with and advisors to the CEO (Boivie et al., 2021), boards are in a position to supplement hands-on inventor CEOs' knowledge and draw their attention to novel technological developments the CEO otherwise would not have the capacity to seek out or pursue. Importantly, though, boards' ability to function in this way will further depend on the nature of their collective experiences, which they will draw on when advising the CEO. In this regard, a characteristic of boards that is particularly relevant to how they might advise hands-on inventor CEOs is their degree of diversity along the dimension of industry experience.

At a general level, diversity is thought to enrich teams' cognitive bases and to represent a wider range of information sources and perspectives, allowing for more creative and innovative discussions (Milliken & Martins, 1996). These dynamics contrast those of more homogenous teams, which have a propensity to maintain the status quo (Wiersema & Bantel, 1992). Applying these concepts to boards, research has found that more diverse boards allocate a higher percentage of meetings to entrepreneurial issues than less diverse boards (Tuggle et al., 2010) and that they also tend to engage in more exploratory innovation (An et al., 2021). Following this logic, boards with more diverse industry experience should be more aware of emerging technologies and trends in other industries and in turn more inclined to propose and discuss innovative ideas and technologies that extend beyond the firm's existing knowledge base (Milliken & Martins, 1996). This should help supplement the CEO's knowledge and alleviate the cognitive constraints of inventors who attempt to directly engage in firm innovation while balancing their managerial responsibilities, specifically by bringing outside ideas to their attention without the CEO having to seek those out on his or her own. Moreover, as inventor CEOs actively lead their R&D teams, they can bring those broader perspectives into meetings and communicate promising ideas to the team. This can facilitate further experimentation by providing a signal that exploration is encouraged and counteracting the typical effects of hands-on involvement on autonomy and output pressure, supporting greater creativity and exploration by R&D personnel (Hughes et al., 2018; Shalley & Gilson, 2004). Thus, we posit:

**Hypothesis 4.** Board industry diversity will weaken the positive (negative) association between an inventor CEO's hands-on involvement in innovation activities and firm exploitative (exploratory) innovation.

# 4 | METHODS

## 4.1 | Sample and data collection

We test our hypotheses using a sample of inventor CEOs of S&P 1500 firms. Consistent with conventional research on corporate-level innovation, we assess innovative outcomes using firm-level patenting (Custódio et al., 2017; Galasso & Simcoe, 2011; Islam & Zein, 2020; Miller et al., 2007). Firm patent data come from the Global Corporate Patent Dataset, which links data from the U.S. Patent and Trademark Office (USPTO) to S&P 1500 firms in Compustat (Bena et al., 2017). We also follow recent work on inventor CEOs by using individual patenting activity as an indicator of CEO inventor experience (Islam & Zein, 2020; van de Wal et al., 2020). We tracked individual patenting histories by matching CEOs in Execucomp to a disambiguated list of inventors from the Harvard Patent Network Dataverse (HPND) (Lai et al., 2011). We used the *reclink* function in Stata 15 to identify fuzzy matches based on standardized names and then compared each CEO's full employment history to the assignee (company) names of matched inventors to confirm whether the CEO had worked for the company where the matched inventor was listed as a patentee. We manually reviewed every possible match and only coded a CEO as an inventor when we were able to confirm that the CEO and the inventor were the same person. Additional firm, board, and executive data come from BoardEx, Institutional Shareholder Services' Directors database, Thomson Reuters' Institutional Holdings (13F) database, and Compustat North America database.

HPND identifies individual inventors and assignees in the USPTO's utility patent database between 1975 and 2010 and we obtain reliable data from Execucomp starting in 1994. Thus, these date ranges set the bounds of our sampling frame from 1994 to 2010. Given our use of patents to measure firm-level innovation, we only include firms in our sample that had at least some patenting during the sampling frame. After combining data for all study variables, we identified 1767 total CEOs of patenting firms in the S&P 1500 with complete data for the years in our study. Of these, 207 (11.7%) had a history of patenting prior to becoming CEO.[3] These individuals form the basis of our final sample of inventor CEOs, which consists of 1097 firm-year observations where the firm filed at least one patent during the year.

[3]This value reflects the percentage of inventor CEOs across all S&P 1500 firms with patenting activity during our sample frame. Some prior work has used narrower samples including companies only in specific high-technology industries. To ensure the number of inventor CEOs we identified was consistent with this work, we examined the proportion of inventor CEOs just in high technology firms across our full panel. Following Islam and Zein (2020), we identified high technology firms based on Loughran and Ritter's (2004) SIC-based classification (see Appendix D of their paper). We found that 20.5 percent of high-technology firms in our panel (from 1994 to 2010) had an inventor CEO. This is comparable to Islam and Zein (2020), who found that 18.7% of their panel (from 1992 to 2008) included an inventor CEO. The slightly higher value in our sample also supports the notion that the percent of inventor CEOs in major corporations seems to be increasing over time.

## 4.2 | Exploitative and exploratory innovation

Our dependent variable reflects the exploitative versus exploratory nature of patents filed by the firm (Lavie et al., 2010). Again, exploitative innovation involves a focus on the firm's existing knowledge base, whereas exploratory innovation reflects innovation that incorporates new knowledge. Consistent with prior work, we operationalize a firms' existing knowledge base as its own patent portfolio as well as other patents it cited over the previous 5 years (i.e., backward citations from $t-6$ to $t-1$) (Custódio et al., 2017). We considered citations to be exploitative if they were included in the firm's existing knowledge base and exploratory if they were not (i.e., not a self-citation or another patent cited by the company during the previous 5 years). We then assessed firm-level exploitative (vs. exploratory) innovation as the proportion of exploitative citations to the total number of exploitative and exploratory citations on patents filed by the firm in $t$ (Choi et al., 2016). Thus, the variable *exploitative innovation* ranges from 0 to 1, where 0 reflects completely exploratory patenting, .5 reflects an even split between exploitative and exploratory patenting, and 1 reflects completely exploitative patenting.[4]

## 4.3 | Inventor CEO hands-on involvement

We assess inventor CEOs' hands-on involvement by considering their pattern of patenting while in the CEO role. Of the group of inventors who rise to the level of CEO in major companies, some continue to appear on patents after being appointed while others do not. We find a fairly even split between these conditions in our sample of inventor CEOs—about 46% were listed on their firms' patents as CEO in at least 1 year during our sampling frame, versus 54% who were not. Such variance is not only empirically useful, as it reflects an individual-level difference that is readily available in inventor CEOs' patenting histories, but we contend that it is also a useful indicator of their hands-on involvement in firm innovation activities.

At a minimum, being listed on firm patents indicates that the CEO takes a direct interest in the technologies coming out of the firm and is seeking acknowledgment for contributing to their creation. This reflects a degree of attention, engagement, and knowledge of the firm's innovation activities that goes beyond simply allocating capital or setting firm-level innovation policies. Indeed, patenting may even reflect an aspect of certain inventor CEOs' identities, in that some may be unwilling to give up the hands-on aspect of innovation even when facing intense managerial responsibilities and job demands. Articles profiling inventor CEOs who continue to patent while in the CEO role help to illustrate this idea. For example, a BusinessWire

[4]Measuring innovative strategy as a proportion allows for parsimonious modeling of our effects that provides a direct indication of the tradeoffs associated with exploitation and exploration in innovation (Lavie et al., 2010). But given some potential limitations of ratio variables (Certo et al., 2020), we conducted a robustness test where we used the unscaled count of exploitative citations as the dependent variable and included the total number of citations on patents filed by the firm as a control. We also conducted additional tests using a number of other variations of exploitative (exploratory) innovation. These included orthogonal measures reflecting the percentage of patents filed by the firm that could be considered as either exploitative or exploratory (Custódio et al., 2017); a measure that excluded any patents filed by the firm where the CEO was listed as a patentee, to ensure those specific patents were not driving our results; and a measure including firms' all-time citations to other patents as part of its knowledge base, rather than just those cited within the previous 5 years. The patterns of relationships across these tests were highly consistent with those of our primary models. Detailed results are provided in Online Appendix A2.

article describing Motorola's former CEO Chris Galvin as "an innovator at heart" (BusinessWire, 2013) and a Forbes article suggesting that Flagship Pioneering's Noubar Afeyan "likes to keep a hand in everything" (Feldman, 2021). Additionally, in contrast to authorship in other creative activities, such as academic research papers, an individual's creative and constructive effort is a legal requirement for formal inventor status, and violating that requirement can invalidate a patent (Ducor, 2000; Haeussler & Sauermann, 2013). Thus, "ghost" authorship by a CEO whereby the CEO would be listed as an inventor without contributing can put a firm at risk of losing its intellectual property. This provides a strong incentive for CEOs to only be listed on patents if they directly contributed to the creative process.

Importantly, we are not suggesting that CEOs who are listed on their firms' patents spend all their time in the lab or that they are involved in every part of the creative process for a particular invention. Neither do we argue that the CEO would be directly involved in every patent produced by the firm. In fact, if inventor CEOs were listed on every patent, or even most patents filed by their firms, that would likely indicate CEO patenting is mostly symbolic rather than reflecting meaningful engagement in innovation activities. But that is not what we find in our sample. Instead, we find that, among inventor CEOs in our sample who are listed on patents after their appointment, the average inventor CEO is listed as a patentee on just 7% of his or her firm's patents. At the same time, these individuals tend to demonstrate considerable consistency in patenting across the years of their tenures. On average, inventor CEOs who patent after being appointed are listed on some of their firms' patents in about 40% of their years as CEO in the sample period. Moreover, about 20% of inventor CEOs in this category patent in 75% or more of sample years, and greater than 10% patent in 90% or more of sample years. Overall, our contention is that the small but consistent level of patenting across the tenures of inventor CEOs who continue to patent, in addition to the broader variance in the number of inventors who do and do not patent after being appointed to the CEO position, provide evidence that being listed on firm patents is a meaningful indicator of inventor CEOs' direct, hands-on involvement in their firms' innovation activities.

Another important note when reflecting on these values is that, because it can take a few years from the inception of an innovative project to develop a technology to the point where a patent would be filed for it (Prodan, 2005), small gaps in inventor CEO patenting do not necessarily mean that an inventor CEO who had been involved in firm patenting was not involved in a gap year. Rather, based on the general consistency with which most hands-on inventor CEOs patent after being appointed, we suggest that their influence would be felt even in years where they were not specifically listed on firm patents, so long as they had recently patented or were in the process of developing technologies that would be patented in the near future. Based on this logic and the previously cited anecdotal evidence, we measure *inventor CEO involvement* as a binary variable, taking the value 1 if the inventor was listed on patents filed by the company while he or she was CEO and within 2 years of the current year (i.e., $t - 2$ to $t + 2$). Otherwise, the variable takes a value of 0.[5]

[5]For robustness, we also tested models using variations of involvement where it was coded 1 only in the years where the CEO was listed on firm patents (i.e., $t$), and when the CEO was listed on firm patents within 1 year of the current year (i.e., $t - 1$ to $t + 1$). In addition, because the amount of patenting by a hands-on inventor CEO may also be important, we tested models using cumulative counts of the number of years in which an inventor CEO patented as well as the number of patents on which the CEO was listed by $t$. Results of these models are presented in Online Appendix A3 and are consistent with those of our primary models.

## 4.4 | Moderators

We coded inventor CEO origin based on two key pieces of information in employment histories we constructed using BoardEx, Execucomp, and executive biographies. The first was whether they had verified employment in an outside firm within 2 years of their appointment, which we used as an initial basis for assessing whether the inventor CEO was an internal or external appointee (Cummings & Knott, 2018; Simsek et al., 2013). The second was their listed titles and roles in the focal company, which we used to identify whether they were a "founder" or "co-founder" of the company (Lee et al., 2017; Lee et al., 2020). Based on this information, we then created several variables to include in different empirical models.

The variable *CEO is insider* takes the value 1 if the inventor was appointed from within the firm or was an original founder of the company. This latter distinction is important because some founders, like Steve Jobs, leave the company but then come back in the CEO role later in their careers. We include this variable in models including our full sample of inventor CEOs, and we also use it as a basis for subsample analyses comparing the influence of insiders to outsiders, where *outsiders* are classified as non-founder CEOs who had verified experience in an outside firm within 2 years of their appointment (Cummings & Knott, 2018; Simsek et al., 2013). In further subsample analyses, we also split the insider variable into *founders* and *other insiders* (i.e., non-founder insiders). In our sample, about 65% of inventor CEOs are insiders, with around 30% being founders and 35% being other insiders. The remaining 35% of inventor CEOs are outsiders.

To assess board industry diversity, we began by identifying all non-executive directors on the board in a given year, based on data from BoardEx. We then compiled comprehensive employment histories for all directors included in the sample. Next, we classified individual directors' primary industry background as the industry where they had the most years of experience prior to *t*, based on two-digit Global Industry Classification Standard (GIC) codes (Hrazdil et al., 2014). Finally, we measured *board industry diversity* using Blau's (1977) index of directors' primary industry backgrounds (Wiersema & Bantel, 1992; Zhu & Shen, 2016). This was calculated as $1-\sum p_i^2$, where pi equals the proportion of directors with primary experience in each industry.

## 4.5 | Controls

We control for factors at multiple levels with potentially confounding effects on our proposed relationships. At the individual level, inventor CEOs' demographic, educational, and managerial backgrounds may affect their likelihood of hands-on involvement and can also be important for firm-level innovative outcomes (Daellenbach et al., 1999; van de Wal et al., 2020). Thus, we control for *CEO age*, whether the *CEO is female*, and whether the CEO has a formal *STEM degree*—that is, a bachelor's, master's, or doctorate in a discipline related to science, technology, engineering, or mathematics. We also control for inventor CEOs' *general management (GM) experience*, calculated as the number of years of experience they had in the GM function prior to becoming CEO (Finkelstein & Hambrick, 1989; Koch et al., 2017).

We also account for CEOs' tenure, duality, and stock ownership, as each of these may affect their levels of power and influence as well as the attention they pay to particular innovative strategies (Latham & Braun, 2009; Li & Yang, 2019; Tabesh et al., 2019). *CEO tenure* equals the number of years the inventor held the CEO position in the firm by *t*; *CEO duality*

is a binary variable indicating whether the CEO is also the chairman of the board; and *CEO ownership* reflects the number of the firm's outstanding shares held by the CEO (measured in millions).

At the firm level, we control for institutional blockholdings, given prior empirical evidence related to the monitoring role of institutional investors and their influence on firm innovation (Aghion et al., 2013; McGrath, 2001). *Institutional blockholding* is calculated as the cumulative number of shares (in billions) that are held by institutional owners who separately hold at least 5% of the firm's outstanding shares (Dalton et al., 2003). The 5% threshold was used to ensure the owners had sufficient stake in the company to pay attention to its strategic actions and performance. We assessed this variable using data from Thompson Reuters' 13F database. We also include *TMT industry diversity* as a complement to our measure of board industry diversity, given the diversity of the executive team can also influence firm strategy (e.g., Zhu et al., 2022).[6]

In addition, because the amount and type of innovations a firm produces may not be independent, we control for firms' *patent count*, which reflects the total number of patents the firm filed during the year. Similarly, we control for *average R&D spending* on a three-year rolling basis (i.e., from $t-3$ to $t-1$) to capture firms' recent emphasis on R&D as an innovative input (Shefer & Frenkel, 2005). We also account for prior financial performance and firm size, as these may further influence both inventor CEOs' level of discretion and their innovative focus (Knott & Vieregger, 2020; Wangrow et al., 2015). We measure prior firm performance using *net income* and firm size using *total assets*, each in $t-1$. Including firm size as a control also allows us to account for the scale of other firm-level controls without introducing issues from adding ratio variables, like R&D intensity or return on assets (Certo et al., 2020). Similarly, we control for firms' total number of *shares outstanding* (in billions) to account for scaling in the CEO and institutional blockholder ownership variables. Finally, we include year and industry dummies (based on GIC codes) across all models.

## 4.6 | Analysis strategy

We use fractional response models to test our hypotheses (Papke & Wooldridge, 1996, 2008). The fractional response model is an extension of the generalized linear model designed to estimate dependent variables that are naturally bounded between zero and one. Traditional linear regression techniques are not suitable for such instances because they "allow predicted values to lie outside the interval determined by the measurement scale" and because they fail to account for the fact that bounded variables "often display non-constant responses to changes in the predictors as they approach the bounds" (Gallani et al., 2015, pp. 3–4). Fractional response models account for these issues by capturing the nonlinearity of the data and predicting response values within the limits of zero and one. They estimate parameters based on a quasi-maximum likelihood method and employ probit or logit regression for the conditional mean (Papke & Wooldridge, 1996). For our models, we employ the *fracreg probit* command in Stata 15, including robust standard errors clustered on firm in all models.

[6]We defined TMT members as non-CEO executives who held a position at or above the level of Executive Vice President (EVP) or Senior Vice President (SVP) (Hambrick et al., 2015). This included executives with the titles of President, Chief Operating Officer, Chief Financial Officer, EVP, and SVP (Boivie et al., 2016; Hambrick et al., 2015). Industry diversity of the TMT was assessed the same way as board industry diversity, using these executives' full employment histories.

## 5 | RESULTS

Given our sample includes all patenting firms in the S&P 1500, rather than just high-technology and R&D intensive firms studied in prior research (Islam & Zein, 2020; van de Wal et al., 2020), we began our analysis by retesting the relationship between inventor CEOs and innovative output in our full initial set of patenting firms. We applied negative binomial regression models using patent counts and citation-weighted patent counts as indicators of innovative intensity (Custódio et al., 2017; Galasso & Simcoe, 2011; Islam & Zein, 2020). Our results replicate past work, showing that firms of inventor CEOs produce more innovations than those of non-inventors (see Table A1-1 in the Online Appendix). Having confirmed this finding in our sample, we now move on to describe the results of tests within the sample of inventor-led firms regarding the implications of inventor CEOs' hands-on involvement on firm exploitative versus exploratory innovation.

### 5.1 | Primary results and tests of hypotheses

Table 1 provides descriptive statistics and correlations for the final sample of inventor-led firms used to test our hypotheses. Descriptive statistics suggest considerable variance on the dependent variable, given a one standard deviation range around the mean of between 20 and 76% of firm patenting reflecting exploitative innovation. The positive correlation between inventor CEO involvement and exploitative innovation ($r = .11$, $p = .00$) also provides some initial support for our main argument that hands-on involvement by an inventor CEO will be associated with more exploitative and less exploratory innovation by the firm. We further test this and our other hypotheses in the fractional response models presented in Table 2.

Hypothesis 1 predicted a positive (negative) relationship between inventor CEO hands-on involvement and firm-level exploitative (exploratory) innovation. This effect is modeled in Table 2, Model 2. Consistent with our prediction, we find a positive coefficient for our measure of inventor CEO hands-on involvement on exploitative innovation ($\beta = .28$, $p = .00$). We interpret this effect by calculating and comparing predicted values of the dependent variable when an inventor CEO was involved in firm patenting within 2 years of the current year, versus when he or she was not. In our sample, hands-on involvement by an inventor CEO is associated with an 11% increase in firm-level exploitative patenting (0.55–0.44 = 0.11). Given the continuous nature of the dependent variable, this suggests that the inverse is also true—that is, hands-on involvement by an inventor CEO is associated with an 11% decrease in exploratory patenting by the firm. These findings offer support for our first hypothesis.

In Hypothesis 2, we argued that hands-on inventor CEOs' origin will moderate their effect on firm innovation such that the positive (negative) association between hands-on involvement and firm exploitative (exploratory) innovation will be stronger for insider inventor CEOs and weaker for outsiders. We test this hypothesis by splitting the sample and separately modeling the effects of involvement for insiders and outsiders in Models 3 and 4, respectively. Results clearly demonstrate that the positive relationship between inventor CEO involvement and innovation type is more apparent for insider inventor CEOs ($\beta = .41$, $p = .00$) relative to outsiders ($\beta = -.01$, $p = .94$). In fact, whereas hands-on involvement increases (decreases) firms' exploitative (exploratory) innovation by 15% for insider inventor CEOs, it has no meaningful influence on exploitative (exploratory) innovation for outsider inventor CEOs. We illustrate these effects in Figure 1, Panels a and b. While this pattern is generally consistent with our arguments, the

**TABLE 1** Descriptive statistics and correlations.

| Variable | | Mean | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Exploitative innovation | 0.48 | 0.28 | | | | | | | | | | | | | | | | | |
| 2 | Patent count | 81.78 | 234.42 | 0.15 | | | | | | | | | | | | | | | | |
| 3 | R&D spending ($t-3$ to $t-1$)[a] | 0.38 | 1.23 | 0.13 | 0.68 | | | | | | | | | | | | | | | |
| 4 | Net income ($t-1$)[a] | 0.37 | 3.09 | 0.04 | 0.52 | 0.35 | | | | | | | | | | | | | | |
| 5 | Total assets ($t-1$)[a] | 13.00 | 74.94 | 0.06 | 0.52 | 0.42 | 0.24 | | | | | | | | | | | | | |
| 6 | Institutional blockholding[b] | 0.02 | 0.05 | 0.08 | 0.12 | 0.50 | −0.07 | 0.09 | | | | | | | | | | | | |
| 7 | Shares outstanding[b] | 0.80 | 2.96 | 0.09 | 0.60 | 0.42 | 0.36 | 0.39 | 0.01 | | | | | | | | | | | |
| 8 | Board industry diversity | 0.44 | 0.27 | 0.02 | 0.20 | 0.24 | 0.14 | 0.18 | 0.12 | 0.22 | | | | | | | | | | |
| 9 | TMT industry diversity | 0.12 | 0.19 | 0.16 | 0.03 | 0.04 | 0.04 | 0.07 | 0.06 | 0.04 | 0.10 | | | | | | | | | |
| 10 | CEO age | 54.18 | 8.02 | −0.14 | −0.09 | −0.03 | −0.02 | −0.01 | −0.02 | −0.09 | 0.08 | −0.10 | | | | | | | | |
| 11 | CEO is female | 0.01 | 0.09 | −0.02 | −0.02 | −0.02 | −0.01 | −0.01 | −0.01 | −0.02 | 0.04 | 0.01 | −0.04 | | | | | | | |
| 12 | CEO STEM degree | 0.37 | 0.48 | 0.08 | 0.01 | −0.01 | −0.02 | −0.05 | 0.00 | −0.06 | −0.12 | −0.14 | 0.06 | −0.07 | | | | | | |
| 13 | CEO GM experience | 4.59 | 6.29 | −0.08 | 0.12 | 0.13 | 0.08 | 0.06 | 0.09 | 0.20 | 0.15 | 0.03 | 0.33 | 0.07 | −0.19 | | | | | |
| 14 | CEO tenure | 8.49 | 7.55 | 0.00 | −0.03 | −0.08 | 0.01 | −0.03 | −0.11 | −0.04 | −0.14 | −0.08 | 0.31 | −0.08 | 0.26 | −0.29 | | | | |
| 15 | CEO duality | 0.51 | 0.50 | −0.01 | −0.03 | −0.05 | 0.07 | 0.08 | −0.07 | −0.04 | 0.10 | −0.02 | 0.33 | 0.09 | −0.05 | 0.02 | 0.20 | | | |
| 16 | CEO ownership[c] | 8.96 | 49.16 | 0.04 | 0.58 | 0.54 | 0.30 | 0.06 | 0.08 | 0.35 | 0.10 | 0.09 | −0.15 | −0.02 | −0.11 | 0.03 | 0.03 | −0.04 | | |
| 17 | CEO is insider | 0.69 | 0.46 | 0.06 | 0.03 | 0.00 | 0.03 | 0.01 | −0.10 | 0.06 | −0.06 | 0.03 | −0.13 | 0.06 | 0.05 | 0.02 | −0.02 | 0.05 | 0.10 | |
| 18 | Inventor CEO involvement | 0.37 | 0.48 | 0.11 | −0.07 | −0.14 | −0.05 | −0.11 | −0.11 | 0.03 | −0.16 | 0.04 | −0.09 | 0.00 | 0.04 | −0.04 | 0.10 | 0.02 | −0.04 | 0.17 |

*Note:* $N = 1097$; correlation $p$-values are available from the authors by request.

[a]R&D spending, net income, and total assets are measured in billions of US dollars.

[b]Institutional blockholding and shares outstanding are measured in billions of shares.

[c]CEO ownership is measured in millions of shares.

null effect for outsiders is somewhat surprising. This finding suggests that outsider inventor CEOs' divergent knowledge and external networks may not just reduce their likelihood of exploitation when engaging directly in the innovative process, but it can fully counteract these tendencies.

Hypothesis 3 extends the logic associated with the moderating influence of CEO origin by arguing that the exploitative tendencies of hands-on inventor CEOs will be strongest for company founders. Tests comparing the effects of involvement for founders in Model 5 ($\beta = .58$, $p = .00$) to other insiders in Model 6 ($\beta = .34$, $p = .00$) support this argument. In our sample, involvement by inventor founder CEOs is associated with a 20% increase (decrease) in exploitative (exploratory) innovation, while the corresponding effect is 12% for other insiders. These effects are plotted in Figure 1, Panels c and d. The pattern of findings is consistent with the argument in our third hypothesis that the main relationship between involvement and innovation type is strongest for inventor founder CEOs.

Finally, Hypothesis 4 posits that board industry diversity should weaken the positive (negative) relationship between an inventor CEO's hands-on involvement and firm exploitative (exploratory) innovation. The associated effect provided in Model 7 of Table 2 is consistent with this hypothesis ($\beta = -.65$, $p = .01$). We interpret this result by calculating and comparing predicted values of exploitative innovation for values at the 10th and 90th percentiles of board industry diversity to, respectively, represent low and high levels of industry diversity. The effects are illustrated in Figure 2 and show that inventor CEO involvement is associated with a 20% increase (decrease) in exploitative (exploratory) innovation when board industry diversity is at its lowest, but that it is not different from zero at high levels of board industry diversity. Similar to the effect of outsider origin, this finding suggests that board industry diversity may not just weaken the relationship between inventor CEO involvement and exploitative (exploratory) innovation, but that highly diverse boards may fully counteract the exploitative tendencies of hands-on inventor CEOs. Thus, Hypothesis 4 is supported.

## 5.2 | Supplemental analyses

We conducted a number of supplemental tests to further explore the mechanisms underlying our hypothesized relationships. First, a key part of our argumentation has to do with the cognitive constraints of engaging directly in the innovative process while managing the other responsibilities of the CEO role in large firms. As we argue, these constraints will tend to narrow hands-on inventor CEOs' focus to incremental innovations, but they can be eased if the CEO comes to the position with more external knowledge or has greater exposure to more diverse industry information. To further demonstrate these mechanisms, we explored whether inventor CEOs' direct experience with industries outside of the focal firm's industry might have a similar negative moderating effect as being appointed as an outsider or working with boards with more diverse industry experience. We examined inventor CEOs' experience with outside industries from directorships they held in other industries in the current year as well as from prior work experience in other industries before becoming CEO. We also considered inventor CEOs' prior GM experience as an additional element of their background that should expand the perspectives they apply when engaging in innovation activities (Campion et al., 1994; Dragoni et al., 2011). Interestingly, we did not find an effect for prior work experience in outside industries; however, we did find meaningful buffering effects for CEOs' contemporaneous directorships in outside industries and their years of GM experience prior to being appointed (see

**TABLE 2** Fractional response models predicting exploitative innovation.

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | | Model 5 | | Model 6 | | Model 7 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All inventor CEOs | | All inventor CEOs | | All insiders | | Outsiders | | Founders | | Other insiders | | All inventor CEOs | |
| **Variable** | ***β*** | ***p*** | ***β*** | ***p*** | ***β*** | ***p*** | ***β*** | ***p*** | ***β*** | ***p*** | ***β*** | ***p*** | ***β*** | ***p*** |
| Constant | −0.80 | (.07) | −0.89 | (.03) | −1.49 | (.00) | −0.98 | (.16) | −2.30 | (.00) | 0.26 | (.62) | −0.93 | (.02) |
| Patent count | 0.00 | (.00) | 0.00 | (.00) | 0.00 | (.01) | 0.00 | (.03) | 0.00 | (.12) | 0.00 | (.20) | 0.00 | (.00) |
| R&D spending ($t-3$ to $t-1$) | 0.01 | (.70) | 0.01 | (.76) | 0.01 | (.85) | 0.05 | (.54) | 0.40 | (.12) | −0.01 | (.93) | 0.00 | (.97) |
| Net income ($t-1$) | −0.02 | (.01) | −0.02 | (.01) | −0.02 | (.01) | 0.05 | (.28) | 0.09 | (.37) | −0.02 | (.01) | −0.02 | (.01) |
| Total assets ($t-1$) | 0.00 | (.01) | 0.00 | (.06) | 0.00 | (.12) | 0.00 | (.06) | −0.04 | (.12) | 0.00 | (.14) | 0.00 | (.03) |
| Institutional blockholding | −0.47 | (.62) | −0.27 | (.77) | −0.18 | (.87) | 0.02 | (.99) | 0.72 | (.73) | −0.19 | (.83) | −0.26 | (.79) |
| Shares outstanding | 0.01 | (.03) | 0.01 | (.29) | 0.01 | (.17) | −0.01 | (.76) | 0.01 | (.68) | 0.13 | (.10) | 0.01 | (.07) |
| Board industry diversity | −0.13 | (.38) | −0.08 | (.59) | −0.24 | (.16) | 0.31 | (.23) | 0.13 | (.57) | −0.62 | (.01) | 0.17 | (.39) |
| TMT industry diversity | 0.48 | (.00) | 0.44 | (.00) | 0.22 | (.22) | 0.77 | (.01) | 0.19 | (.50) | 0.24 | (.30) | 0.47 | (.00) |
| CEO age | −0.01 | (.04) | −0.01 | (.08) | −0.01 | (.10) | −0.02 | (.30) | 0.00 | (.72) | −0.02 | (.09) | −0.01 | (.05) |
| CEO is female | −0.40 | (.08) | −0.38 | (.16) | −0.35 | (.22) | | | 0.00 | (.99) | −1.03 | (.00) | −0.32 | (.15) |
| CEO STEM degree | 0.14 | (.11) | 0.14 | (.10) | 0.21 | (.05) | 0.02 | (.88) | 0.32 | (.07) | 0.15 | (.27) | 0.16 | (.06) |
| CEO GM experience | 0.00 | (.55) | −0.01 | (.42) | −0.01 | (.52) | 0.01 | (.70) | −0.02 | (.13) | 0.00 | (.93) | 0.00 | (.62) |
| CEO tenure | 0.00 | (.74) | −0.01 | (.42) | −0.01 | (.47) | 0.00 | (.78) | −0.02 | (.14) | 0.01 | (.38) | 0.00 | (.54) |
| CEO duality | 0.21 | (.02) | 0.21 | (.02) | 0.21 | (.04) | 0.25 | (.15) | 0.29 | (.11) | 0.25 | (.01) | 0.20 | (.02) |
| CEO ownership | 0.00 | (.03) | 0.00 | (.09) | 0.00 | (.56) | −0.03 | (.03) | 0.00 | (.27) | 0.00 | (.88) | 0.00 | (.07) |
| CEO is insider | 0.00 | (.98) | −0.03 | (.73) | | | | | | | | | −0.06 | (.48) |
| Inventor CEO involvement | | | 0.28 | (.00) | 0.41 | (.00) | −0.01 | (.94) | 0.58 | (.00) | 0.34 | (.00) | 0.54 | (.00) |
| Inventor CEO involvement × board industry diversity | | | | | | | | | | | | | −0.65 | (.01) |

**TABLE 2** (Continued)

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | | Model 5 | | Model 6 | | Model 7 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All inventor CEOs | | All inventor CEOs | | All insiders | | Outsiders | | Founders | | Other insiders | | All inventor CEOs | |
| **Variable** | *β* | *p* | *β* | *p* | *β* | *p* | *β* | *p* | *β* | *p* | *β* | *p* | *β* | *p* |
| Industry dummies | Included | | Included | | Included | | Included | | Included | | Included | | Included | |
| Year dummies | Included | | Included | | Included | | Included | | Included | | Included | | Included | |
| Observations | 1097 | | 1097 | | 760 | | 337 | | 373 | | 387 | | 1097 | |
| Pseudo *R*-squared | 0.058 | | 0.064 | | 0.079 | | 0.075 | | 0.122 | | 0.077 | | 0.067 | |

*Note*: *p*-Values in parentheses; all models include robust standard errors, clustered on firm. Models 3 through 6 split the sample by CEO origin. Thus, we omit the variable *CEO is insider* from these models. The variable *CEO is female* is omitted from Model 4 because our sample contains no female, outside inventor CEOs.

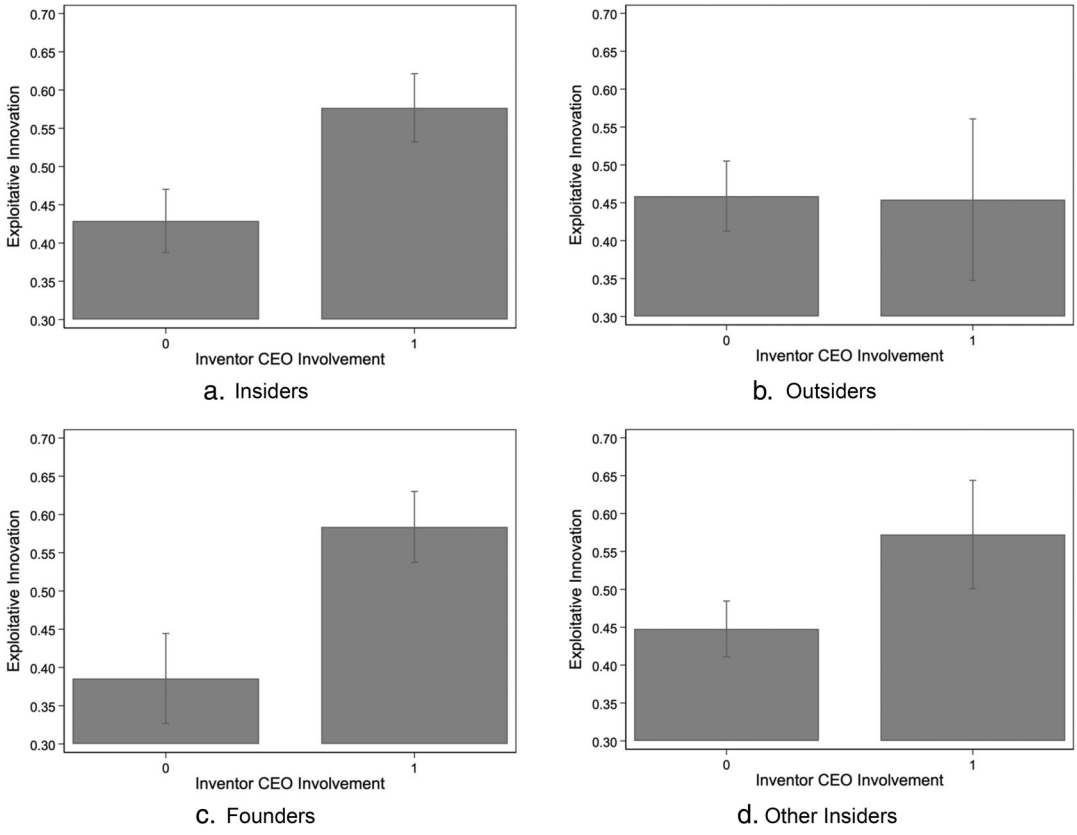


**FIGURE 1** Inventor CEO involvement on exploitative innovation by CEO origin.

Online Appendix, Table A4-1). These findings offer additional supportive evidence of the cognitive mechanisms underlying our results, which we suggest are likely to have residual consequences for the innovative pursuits of other R&D personnel (Livingston, 2003; Love et al., 2017; Scott & Bruce, 1994; Simsek, 2007).

Second, we conducted analyses aimed at isolating the specific moderating effects that can be attributed to founder origin. This was important because of the robust correlations between founder origin and other characteristics of inventor CEOs' positions that could have similar effects but for different underlying reasons. Specifically, founder origin was highly correlated with both inventor CEO tenure (.39) and duality (.15). Each of these variables could contribute to inventor CEOs' influence and embeddedness but would not be associated with the same sense of ownership and connection that we would expect of founders, nor the particular level of influence they would have on other R&D personnel. Of course, controlling for these variables in our primary models provides a certain degree of confidence that the founder effect exists above and beyond the effects of tenure and duality. But to better understand how founder origin may differ from tenure and duality, we also directly tested the potential moderating influence of these variables on the main relationship between hands-on involvement and exploitative (exploratory) innovation. Neither tenure nor duality moderated the main relationship (see Online Appendix, Table A4-1). These null results underscore that the effects observed in our

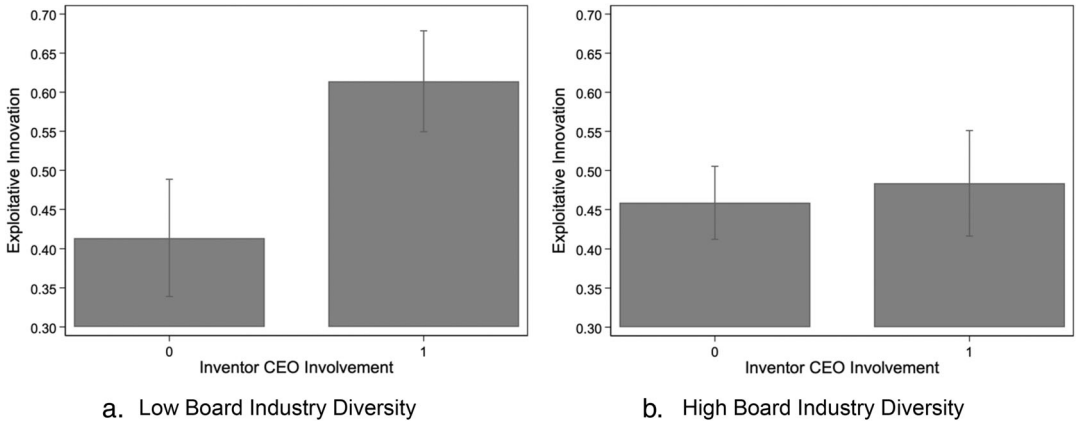


**FIGURE 2** Inventor CEO involvement on exploitative innovation by board industry diversity level.

primary models are uniquely associated with founder origin and not merely the result of inventor founders CEOs' longer tenures or tendencies to also hold the board chair position.

Finally, we tested supplemental models to better understand how different types of board diversity might affect the main relationship between hands-on involvement and exploitative (exploratory) innovation. To do so, we tested the potential moderating impacts of age, tenure, gender, and functional background diversity of the board. None of these alternative forms of board diversity had any observable effect on our main relationship (see Table A4-2). This provides additional evidence of the mechanism we describe for boards' industry diversity, as a particularly relevant form of diversity when considering the relationship between inventor CEOs' hands-on involvement and firms' innovative trajectories.

## 5.3 | Endogeneity

We also conducted tests to mitigate potential sources of endogeneity and to further ensure the robustness of our analyses. First, we examined potential selection bias arising from inventor CEOs being appointed with mandates to engage in innovation activities to exploit existing firm knowledge. To do so, we estimated logistic regression models where we used different variations of firms' prior exploitative (exploratory) innovation to predict inventor CEOs' involvement in firm patenting after being appointed to the CEO role. Our results indicated no predictive relationship, suggesting that CEO involvement was not solely driven by their mandate. Second, we addressed possible sample-induced endogeneity from excluding firms not filing patents. We used Heckman's two-stage modeling approach to confirm that sample selection did not bias our primary analyses. Finally, we considered omitted variable bias by employing the robustness of inference to replacement (RIR) method. Results suggested that the primary relationship between inventor CEO involvement and exploitative (exploratory) innovation is robust, with RIR values indicating high resistance to potential confounding variables. Further conceptual and empirical evidence also suggested that the interactions in our subsequent hypotheses are each robust to omitted variable bias. More detail about each of these tests is provided in Online Appendix 5. Overall, these tests suggest that our results are robust to various forms of

endogeneity that are common in secondary research, enhancing our confidence in the reported relationships.

## 6 | DISCUSSION

The goal of this article was to answer the question, how do inventor CEOs influence the nature of innovation produced by their firms? To do so, we considered how inventor CEOs' hands-on involvement in innovation activities influences their firms' exploitative versus exploratory innovation. We also considered other characteristics of firms' leaders with the potential to contextualize inventor CEOs' hands-on involvement and further determine how it affects firms' innovative trajectories. Our primary results indicate that hands-on involvement by inventor CEOs appointed from within the firm, and particularly firm founders, is positively (negatively) associated with exploitative (exploratory) innovation, but that board industry diversity can attenuate the exploitative tendencies of hands-on inventor CEOs. Supplemental analyses also provide evidence of a similar buffering influence for inventor CEOs' GM experience and board appointments in outside industries, demonstrating further evidence for some of the key mechanisms we describe in our theorizing.

### 6.1 | Contributions to theory and practice

Our theory and findings contribute to a more complete understanding of inventor CEOs' effects on innovation in large established firms. In emphasizing inventor CEOs' influence on general innovative output (i.e., patent counts), prior research has implicitly assumed both that inventor CEOs all behave similarly and that they have similar positive effects on firm innovation (Islam & Zein, 2020; van de Wal et al., 2020). We challenge and extend this view by arguing and finding that differences among inventor CEOs can have important implications for their firms' innovative trajectories. By focusing on inventor CEOs' continued patenting, in particular, we are able to distinguish between CEOs who bring their specialized skills into play after being appointed CEO and those who do not. Thus, our theory and findings begin to open up the black box of how different inventor CEOs behave and how they actually contribute to their firms' innovation processes. We also demonstrate that their impact on firm innovation is significantly different. Again, these findings are important for both theory and practice because the specific approach a firm takes to innovation has implications for the value of its innovations and, in turn, the firm's ability to create or sustain a competitive advantage and promote positive performance (He & Wong, 2004; Jansen et al., 2006; Uotila et al., 2009).

Another intriguing implication of our findings is what they suggest about the long-term versus short-term orientation of inventor CEOs who stay involved in firm patenting. Although numerous pressures exist for managers, especially of large established firms, to take more of a short-term approach to strategy formulation and implementation (Christensen, 1997; Latham & Braun, 2009; Li & Yang, 2019; March, 1991), scholars have pointed to various characteristics of CEOs that may counteract these pressures, including certain cognitive styles and types of experience (Custódio et al., 2017; De Visser & Faems, 2015; Kiss et al., 2020). Interestingly, inventor CEO involvement appears to not work this way. Our findings suggest that inventor CEO involvement may lead to short-term exploitive innovation, for reasons the prior literature on managerial short-termism has yet to fully explore.

Our theory and findings also add to research on the antecedents of exploratory and exploitative innovation (Lavie et al., 2010; March, 1991). Most research in this area has focused on factors that promote ambidexterity, or the simultaneous pursuit of exploratory and exploitative innovation, with a particular emphasis on organizational and environmental factors (see Lavie et al., 2010). But given the significant tradeoffs between these two approaches (Andriopoulos & Lewis, 2009; Uotila et al., 2009), many firms' innovative portfolios are likely to favor one over the other. We extend research in this area by showing that inventor CEOs' hands-on involvement can influence how firms manage this tradeoff. While inventor CEO involvement is likely to shift the balance of firm innovation in favor of exploitation, especially for founders and other insiders, other factors associated with their access to external knowledge and GM experience may attenuate hands-on inventor CEOs' exploitative tendencies and potentially encourage a more balanced approach to innovation.

## 6.2 | Limitations and directions for future research

Despite its contributions, there are also several opportunities for future research to build on our study. First, because we sampled from the S&P 1500, we were only able to observe innovative outcomes in firms that had already been founded and grown to a certain size. In outlining our hypotheses for founder CEOs, in particular, we make an assumption that many inventors with managerial aspirations are likely to leverage the technologies they developed to found their own companies. While this assumption is based on correlational evidence in past work, we certainly do not provide any causal evidence here. Future research might be able to track individual inventors over time to more directly determine whether or when they are likely to found companies, become CEO, and/or retain the CEO position in the firm as it grows. Future research may also benefit by exploring CEO succession events to develop our understanding of how experience with patenting or other factors impact the selection of inventors as CEOs.

Second, while our use of the broader S&P 1500 extends beyond work on inventor CEOs that has focused on a select group of large high technology or R&D intensive firms (Islam & Zein, 2020; van de Wal et al., 2020), our measure of firm-level innovation still necessitated that we restrict our sample to firms that filed patents during the sample period. Recent work has begun to explore alternative means of measuring firm-level innovation outside of the more traditional measures based on R&D or patenting activity. For instance, Bellstam et al. (2021) recently introduced a text-based measure of innovation based on analyst reports, which they showed was strongly correlated with patent quality for patenting firms, but can also be applied to non-patenting firms. Future research could use this or other measures of innovation (e.g., new product introductions, trademarks, etc.) to expand on our study and better understand how inventor CEOs affect innovation outside of the universe of patenting firms. Such an approach would also lend itself to a more comprehensive view of CEOs' or other executives' technological expertise outside of their patenting experience (van de Wal et al., 2020).

Finally, comparing our findings with prior research offers intriguing opportunities for future research. For example, prior work has found that overconfident CEOs are more likely to pursue innovation and take their firms in new technological directions (Galasso & Simcoe, 2011). Other studies have shown that founder CEOs are more overconfident than professional CEOs (Lee et al., 2017). Taken together, these studies seem to suggest that founder origin should be positively associated with exploratory innovation. Likewise, previous studies suggest that founders tend to have high cognitive flexibility (Dheer & Lenartowicz, 2019) which may be

associated with more effortful and persistent information search that promotes organizational ambidexterity. Of course, these findings seem contrary to our argument and finding that founder origin will encourage greater exploitative innovation by inventors who continue to be directly involved in patenting post appointment. But one way these studies may reconcile with ours is if overconfident and cognitively flexible CEOs are less likely to directly engage in their firms' innovation activities. Ultimately, this is an empirical question that future research could address.

## 7 | CONCLUSION

This study expands our understanding of how inventor CEOs influence corporate innovation in large, established firms. While prior research has demonstrated that inventor CEOs increase firms' overall innovative output relative to non-inventor CEOs, our findings reveal more complex and contingent effects, in that inventor CEOs' hands-on involvement can shift their firms' innovative trajectories toward more exploitative and less exploratory innovation. This tendency is particularly pronounced for insider inventor CEOs, especially founders, but can be mitigated when firms have boards with greater industry diversity or when inventor CEOs have broader external experience outside the firm's core industry. By uncovering these relationships, our study clarifies some of the tradeoffs firms face by appointing inventors as CEOs and highlights how additional characteristics of firms' leaders help determine whether inventor CEO involvement results in a bias toward incremental or more radical forms of innovation. Overall, our findings point to important contingencies that should be considered as inventors continue to rise to CEO positions in major corporations worldwide.

### ACKNOWLEDGMENTS

The authors express their thanks for thoughtful comments provided by various faculty and doctoral students during seminars presented at Penn State University, the University of Tennessee, and the University of Oklahoma. The authors also acknowledge instrumental feedback and editorial guidance from Dovev Lavie and two anonymous reviewers while developing this research.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

### ORCID

*Joseph S. Harrison* https://orcid.org/0000-0002-4835-0566
*Steven Boivie* https://orcid.org/0000-0002-3811-1609
*Ithai Stern* https://orcid.org/0000-0003-0371-7173
*Joseph Porac* https://orcid.org/0000-0003-0737-3865

### REFERENCES

Aghion, P., Van Reenen, J., & Zingales, L. (2013). Innovation and institutional ownership. *American Economic Review*, *103*(1), 277–304.

Alber, L. A. (2014). The CEO of Williams-Sonoma on blending instinct with analysis. *Harvard Business Review*, *92*(9), 41–44.

Alvarez, S. A., & Porac, J. (2020). Imagination, indeterminacy, and managerial choice at the limit of knowledge. *Academy of Management Review*, *45*(4), 735–744.

An, H., Chen, C. R., Wu, Q., & Zhang, T. (2021). Corporate innovation: Do diverse boards help? *Journal of Financial and Quantitative Analysis*, *56*(1), 155–182.

Andriopoulos, C., & Lewis, M. W. (2009). Exploitation-exploration tensions and organizational ambidexterity: Managing paradoxes of innovation. *Organization Science*, *20*(4), 696–717.

Barker, V. L., & Mueller, G. C. (2002). CEO characteristics and firm R&D spending. *Management Science*, *48*(6), 782–801.

Bellstam, G., Bhagat, S., & Cookson, J. A. (2021). A text-based analysis of corporate innovation. *Management Science*, *67*(7), 4004–4031.

Bena, J., Ferreira, M. A., Matos, P., & Pires, P. (2017). Are foreign investors locusts? The long-term effects of foreign institutional ownership. *Journal of Financial Economics*, *126*(1), 122–146.

Benner, M. J., & Tushman, M. L. (2015). Reflections on the 2013 decade award—"Exploitation, exploration, and process management: The productivity dilemma revisited" ten years later. *Academy of Management Review*, *40*(4), 497–514.

Blau, P. M. (1977). *Inequality and heterogeneity: A primitive theory of social structure*. Free Press.

Boivie, S., Graffin, S. D., Oliver, A. G., & Withers, M. C. (2016). Come aboard! Exploring the effects of directorships in the executive labor market. *Academy of Management Journal*, *59*(5), 1681–1706.

Boivie, S., Withers, M. C., Graffin, S. D., & Corley, K. G. (2021). Corporate directors' implicit theories of the roles and duties of boards. *Strategic Management Journal*, *42*(9), 1662–1695.

Boumgarden, P., Nickerson, J., & Zenger, T. R. (2012). Sailing into the wind: Exploring the relationships among ambidexterity, vacillation, and organizational performance. *Strategic Management Journal*, *33*(6), 587–610.

Busenbark, J. R., Krause, R., Boivie, S., & Graffin, S. D. (2016). Toward a configurational perspective on the CEO a review and synthesis of the management literature. *Journal of Management*, *42*(1), 234–268.

Busenitz, L. W., & Barney, J. B. (1997). Differences between entrepreneurs and managers in large organizations: Biases and heuristics in strategic decision-making. *Journal of Business Venturing*, *12*(1), 9–30.

BusinessWire. (2013). Nanomech announces christopher galvin joins board of directors. Retrieved from https://www.businesswire.com/news/home/20130508005467/en/NanoMech®-Announces-Christopher-Galvin-Joins-Board-of-Directors

Byun, S. K., Fuller, K., & Lin, Z. (2021). The costs and benefits associated with inventor CEOs. *Journal of Corporate Finance*, *71*, 102094.

Campion, M. A., Cheraskin, L., & Stevens, M. J. (1994). Career-related antecedents and outcomes of job rotation. *Academy of Management Journal*, *37*(6), 1518–1542.

Cannella, A. A., & Holcomb, T. R. (2005). A multi-level analysis of the upper-echelons model. In F. Dansereau & F. J. Yammarino (Eds.), *Multi-level issues in strategy and methods* (pp. 195–237). Elsevier Science.

Cardon, M. S., Zietsma, C., Saparito, P., Matherne, B. P., & Davis, C. (2005). A tale of passion: New insights into entrepreneurship from a parenthood metaphor. *Journal of Business Venturing*, *20*(1), 23–45.

Carson, R. T., Graff Zivin, J., Louviere, J. J., Sadoff, S., & Shrader, J. G. (2022). The risk of caution: Evidence from an experiment. *Management Science*, *68*(12), 9042–9060.

Certo, S. T., Busenbark, J. R., Kalm, M., & LePine, J. A. (2020). Divided we fall: How ratios undermine research in strategic management. *Organizational Research Methods*, *23*(2), 211–237.

Certo, S. T., Covin, J. G., Daily, C. M., & Dalton, D. R. (2001). Wealth and the effects of founder management among IPO-stage new ventures. *Strategic Management Journal*, *22*(6–7), 641–658.

Choi, B., Kumar, M. V. S., & Zambuto, F. (2016). Capital structure and innovation trajectory: The role of debt in balancing exploration and exploitation. *Organization Science*, *27*(5), 1183–1201.

Christensen, C. M. (1997). *The innovator's dilemma: When new technologies cause great firms to fail*. Harvard Business Review Press.

Clark, K. B., & Wheelwright, S. C. (1992). Organizing and leading "heavyweight" development teams. *California Management Review*, *34*(3), 9–28.

Cooper, A. C., Woo, C. Y., & Dunkelberg, W. C. (1988). Entrepreneurs' perceived chances for success. *Journal of Business Venturing*, *3*(2), 97–108.

Cowan, R., Jonard, N., & Zimmermann, J.-B. (2007). Bilateral collaboration and the emergence of innovation networks. *Management Science*, *53*(7), 1051–1067.

Cummings, T., & Knott, A. M. (2018). Outside CEOs and innovation. *Strategic Management Journal*, *39*(8), 2095–2119.

Custódio, C., Ferreira, M. A., & Matos, P. (2017). Do general managerial skills spur innovation? *Management Science*, *65*(2), 459–476.

Daellenbach, U. S., McCarthy, A. M., & Schoenecker, T. S. (1999). Commitment to innovation: The impact of top management team characteristics. *R&D Management*, *29*(3), 199–208.

Dahlander, L., O'Mahony, S., & Gann, D. M. (2016). One foot in, one foot out: How does individuals' external search breadth affect innovation outcomes? *Strategic Management Journal*, *37*(2), 280–302.

Dalton, D. R., Daily, C. M., Certo, S. T., & Roengpitya, R. (2003). Meta-analyses of financial performance and equity: Fusion or confusion? *Academy of Management Journal*, *46*(1), 13–26.

Danneels, E. (2002). The dynamics of product innovation and firm competencies. *Strategic Management Journal*, *23*(12), 1095–1121.

Davis, D. (2018). *CU alumnus George "Doc" Lopez receives honorary doctorate of humane letters*. University of Colorado Alumni Association. Retrieved from https://web.cvent.com/event/4e185dc1-f2f5-4453-8648-f2e06a271938/websitePage:c0123f9e-0aae-4e87-afcc-b0592e4e266a

De Visser, M., & Faems, D. (2015). Exploration and exploitation within firms: The impact of CEO s' cognitive style on incremental and radical innovation performance. *Creativity and Innovation Management*, *24*(3), 359–372.

Dheer, R. J., & Lenartowicz, T. (2019). Cognitive flexibility: Impact on entrepreneurial intentions. *Journal of Vocational Behavior*, *115*, 103339.

Dragoni, L., Oh, I.-S., Vankatwyk, P., & Tesluk, P. E. (2011). Developing executive leaders: The relative contribution of cognitive ability, personality, and the accumulation of work experience in predicting strategic thinking competency. *Personnel Psychology*, *64*(4), 829–864.

Ducor, P. (2000). Coauthorship and coinventorship. *Science*, *289*(5481), 873–875.

Eggers, J. P., & Kaplan, S. (2008). Cognition and renewal: Comparing CEO and organizational effects on incumbent adaptation to technical change. *Organization Science*, *20*(2), 461–477.

Feldman, A. (2021). The billionaire chairman of vaccine maker Moderna wants to reinvent scientific entrepreneurship. *Forbes* Retrieved from https://www.forbes.com/sites/amyfeldman/2021/11/15/the-billionaire-chairman-of-vaccine-maker-moderna-wants-to-reinvent-scientific-entrepreneurship/?sh=cb55284166ce

Finkelstein, S., & Hambrick, D. C. (1989). Chief executive compensation: A study of the intersection of markets and political processes. *Strategic Management Journal*, *10*(2), 121–134.

Galasso, A., & Simcoe, T. S. (2011). CEO overconfidence and innovation. *Management Science*, *57*(8), 1469–1484.

Gallani, S., Krishnan, R., & Wooldridge, J. M. (2015). *Applications of fractional response model to the study of bounded dependent variables in accounting research*. Harvard Business School.

Gerstner, W.-C., König, A., Enders, A., & Hambrick, D. C. (2013). CEO narcissism, audience engagement, and organizational adoption of technological discontinuities. *Administrative Science Quarterly*, *58*(2), 257–291.

Gopi, P. (2013). Interview with the president and CEO: Applied Micro Circuits Corporation (AMCC). *The Wall Street Transcript*. Retrieved from https://www.twst.com/interview/interview-with-the-president-and-ceo-applied-micro-circuits-corporation-amcc

Graebner, M. E., & Eisenhardt, K. M. (2004). The seller's side of the story: Acquisition as courtship and governance as syndicate in entrepreneurial firms. *Administrative Science Quarterly*, *49*(3), 366–403.

Grigoriou, K., & Rothaermel, F. T. (2017). Organizing for knowledge generation: Internal knowledge networks and the contingent effect of external knowledge sourcing. *Strategic Management Journal*, *38*(2), 395–414.

Haeussler, C., & Sauermann, H. (2013). Credit where credit is due? The impact of project contributions and social factors on authorship and inventorship. *Research Policy*, *42*(3), 688–703.

Hambrick, D. C., Humphrey, S. E., & Gupta, A. (2015). Structural interdependence within top management teams: A key moderator of upper echelons predictions. *Strategic Management Journal*, *36*(3), 449–461.

Haveman, H. A. (1993). Ghost of managers past: Managerial succession and organizational mortality. *Academy of Management Journal*, *36*(4), 864–881.

He, Z.-L., & Wong, P.-K. (2004). Exploration vs. exploitation: An empirical test of the ambidexterity hypothesis. *Organization Science*, *15*(4), 481–494.

Hendricks, B., Howell, T., & Bingham, C. (2019). How much do top management teams matter in founder-led firms? *Strategic Management Journal*, *40*(6), 959–986.

Howell, J. M., & Higgins, C. A. (1990). Champions of technological innovation. *Administrative Science Quarterly*, *35*(2), 317–341.

Hrazdil, K., Trottier, K., & Zhang, R. (2014). An intra-and inter-industry evaluation of three classification schemes common in capital market research. *Applied Economics*, *46*(17), 2021–2033.

Hughes, D. J., Lee, A., Tian, A. W., Newman, A., & Legood, A. (2018). Leadership, creativity, and innovation: A critical review and practical recommendations. *The Leadership Quarterly*, *29*(5), 549–569.

Islam, E., & Zein, J. (2020). Inventor CEOs. *Journal of Financial Economics*, *135*(2), 505–527.

Jansen, J. J. P., Van Den Bosch, F. A. J., & Volberda, H. W. (2006). Exploratory innovation, exploitative innovation, and performance: Effects of organizational antecedents and environmental moderators. *Management Science*, *52*(11), 1661–1674.

Kanter, R. (1985). Supporting innovation and venture development in established companies. *Journal of Business Venturing*, *1*(1), 47–60.

Kanter, R. M. (1983). *The change masters*. Simon and Schuster.

Katila, R., Thatchenkery, S., Christensen, M. Q., & Zenios, S. (2017). Is there a doctor in the house? Expert product users, organizational roles, and innovation. *Academy of Management Journal*, *60*(6), 2415–2437.

Kiss, A. N., Libaers, D., Barr, P. S., Wang, T., & Zachary, M. A. (2020). CEO cognitive flexibility, information search, and organizational ambidexterity. *Strategic Management Journal*, *41*(12), 2200–2233.

Knott, A. M., & Vieregger, C. (2020). Reconciling the firm size and innovation puzzle. *Organization Science*, *31*(2), 477–488.

Koch, M., Forgues, B., & Monties, V. (2017). The way to the top: Career patterns of Fortune 100 CEOs. *Human Resource Management*, *56*, 267–285.

Kurzhals, C., Graf-Vlachy, L., & König, A. (2020). Strategic leadership and technological innovation: A comprehensive review and research agenda. *Corporate Governance: An International Review*, *28*(6), 437–464.

Lai, R., D'Amour, A., Yu, A., Sun, Y., & Fleming, L. (2011). Disambiguation and co-authorship networks of the U.S. Patent inventor database (1975–2010). Science HIoQS (ed.), Harvard Dataverse, V5.

Latham, S. F., & Braun, M. (2009). Managerial risk, innovation, and organizational decline. *Journal of Management*, *35*(2), 258–281.

Lavie, D., Stettner, U., & Tushman, M. L. (2010). Exploration and exploitation within and across organizations. *Academy of Management Annals*, *4*(1), 109–155.

Lee, J. M., Hwang, B.-H., & Chen, H. (2017). Are founder CEOs more overconfident than professional CEOs? Evidence from S&P 1500 companies. *Strategic Management Journal*, *38*(3), 751–769.

Lee, J. M., Yoon, D., & Boivie, S. (2020). Founder CEO succession: The role of CEO organizational identification. *Academy of Management Journal*, *63*(1), 224–245.

Levinthal, D. A., & March, J. G. (1993). The myopia of learning. *Strategic Management Journal*, *14*(S2), 95–112.

Li, M., & Yang, J. (2019). Effects of CEO duality and tenure on innovation. *Journal of Strategy and Management*, *12*(4), 536–552.

Li, Q., Maggitti, P. G., Smith, K. G., Tesluk, P. E., & Katila, R. (2013). Top management attention to innovation: The role of search selection and intensity in new product introductions. *Academy of Management Journal*, *56*(3), 893–916.

Lin, Z., Patel, P., & Oghazi, P. (2021). The value of managerial ability and general ability for inventor CEOs. *Journal of Business Research*, *135*, 78–98.

Livingston, J. S. (2003). Pygmalion in management. *Harvard Business Review*, *81*(1), 97–106.

Loughran, T., & Ritter, J. (2004). Why has IPO underpricing changed over time? *Financial Management*, *33*(3), 5–37.

Love, E. G., Lim, J., & Bednar, M. K. (2017). The face of the firm: The influence of CEOs on corporate reputation. *Academy of Management Journal*, *60*(4), 1462–1481.

Mainemelis, C., Kark, R., & Epitropaki, O. (2015). Creative leadership: A multi-context conceptualization. *Academy of Management Annals*, *9*(1), 393–482.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science*, *2*(1), 71–87.

Markoff, J. (2011). Steven P. Jobs, 1955-2011: Apple's visionary redefined digital age. *The New York Times*. Retrieved from https://www.nytimes.com/2011/10/06/business/steve-jobs-of-apple-dies-at-56.html

McGrath, R. G. (2001). Exploratory learning, innovative capacity, and managerial oversight. *Academy of Management Journal*, *44*(1), 118–131.

Miller, D. (1983). The correlates of entrepreneurship in three types of firms. *Management Science*, *29*(7), 770–791.

Miller, D. B. (1986). *Managing professionals in research and development*. Jossey-Bass.

Miller, D. J., Fern, M. J., & Cardinal, L. B. (2007). The use of knowledge for technological innovation within diversified firms. *Academy of Management Journal*, *50*(2), 307–326.

Milliken, F. J., & Martins, L. L. (1996). Searching for common threads: Understanding the multiple effects of diversity in organizational groups. *Academy of Management Review*, *21*(2), 402–433.

Mudambi, R., & Swift, T. (2014). Knowing when to leap: Transitioning between exploitative and explorative R&D. *Strategic Management Journal*, *35*(1), 126–145.

Nadkarni, S., & Chen, J. (2014). Bridging yesterday, today, and tomorrow: CEO temporal focus, environmental dynamism, and rate of new product introduction. *Academy of Management Journal*, *57*(6), 1810–1833.

Papke, L. E., & Wooldridge, J. M. (1996). Econometric methods for fractional response variables with an application to 401 (k) plan participation rates. *Journal of Applied Econometrics*, *11*(6), 619–632.

Papke, L. E., & Wooldridge, J. M. (2008). Panel data methods for fractional response variables with an application to test pass rates. *Journal of Econometrics*, *145*(1–2), 121–133.

Paruchuri, S. (2010). Intraorganizational networks, interorganizational networks, and the impact of central inventors: A longitudinal study of pharmaceutical firms. *Organization Science*, *21*(1), 63–80.

Paruchuri, S., & Awate, S. (2017). Organizational knowledge networks and local search: The role of intra-organizational inventor networks. *Strategic Management Journal*, *38*(3), 657–675.

Prodan, I. (2005). Influence of research and development expenditures on number of patent applications: Selected case studies in OECD countries and central Europe, 1981-2001. *Applied Econometrics and International Development*, *5*(4), 5–22.

Quigley, T. J., Hambrick, D. C., Misangyi, V. F., & Rizzi, G. A. (2019). CEO selection as risk-taking: A new vantage on the debate about the consequences of insiders versus outsiders. *Strategic Management Journal*, *40*(9), 1453–1470.

Reagans, R., & Zuckerman, E. W. (2001). Networks, diversity, and productivity: The social capital of corporate R&D teams. *Organization Science*, *12*(4), 502–517.

Runst, P., & Thomä, J. (2022). Does personality matter? Small business owners and modes of innovation. *Small Business Economics*, *58*(4), 2235–2260.

Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal*, *37*(3), 580–607.

Shalley, C. E., & Gilson, L. L. (2004). What leaders need to know: A review of social and contextual factors that can foster or hinder creativity. *The Leadership Quarterly*, *15*(1), 33–53.

Shefer, D., & Frenkel, A. (2005). R&D, firm size and innovation: An empirical analysis. *Technovation*, *25*(1), 25–32.

Shen, W., & Cannella, A. A. (2002). Revisiting the performance consequences of CEO succession: The impacts of successor type, postsuccession senior executive turnover, and departing CEO tenure. *Academy of Management Journal*, *45*(4), 717–733.

Siegel, S. M., & Kaemmerer, W. F. (1978). Measuring the perceived support for innovation in organizations. *Journal of Applied Psychology*, *63*(5), 553–562.

Simsek, Z. (2007). CEO tenure and organizational performance: An intervening model. *Strategic Management Journal*, *28*(6), 653–662.

Simsek, Z., Hsu, P., Heavey, C., & Bereskin, F. (2013). Executive succession and organizational innovation. *Proceedings of the Academy of Management*, *2013*(1), 11459.

Singh, H., Kryscynski, D., Li, X., & Gopal, R. (2016). Pipes, pools, and filters: How collaboration networks affect innovative performance. *Strategic Management Journal*, *37*(8), 1649–1666.

Slusher, A., Van Dyke, J., & Rose, G. (1972). Technical competence of group leaders, managerial role, and productivity in engineering design groups. *Academy of Management Journal*, *15*(2), 197–204.

Snyder, B. (2019). *How innovation drives economic growth*. Insights by Stanford Business. Retrieved from https://www.gsb.stanford.edu/insights/how-innovation-drives-economic-growth

Tabesh, P., Vera, D., & Keller, R. T. (2019). Unabsorbed slack resource deployment and exploratory and exploitative innovation: How much does CEO expertise matter? *Journal of Business Research*, *94*, 65–80.

Tuggle, C. S., Schnatterly, K., & Johnson, R. A. (2010). Attention patterns in the boardroom: How board composition and processes affect discussion of entrepreneurial issues. *Academy of Management Journal*, *53*(3), 550–571.

Tushman, M. L., & O'Reilly, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, *38*(4), 8–29.

Uotila, J., Maula, M., Keil, T., & Zahra, S. A. (2009). Exploration, exploitation, and financial performance: Analysis of S&P 500 corporations. *Strategic Management Journal*, *30*(2), 221–231.

van de Wal, N., Boone, C., Gilsing, V., & Walrave, B. (2020). CEO research orientation, organizational context, and innovation in the pharmaceutical industry. *R&D Management*, *50*(2), 239–254.

Waikar, S. (2019). How much does innovation drive economic growth? *KelloggInsight* Retrieved from https://insight.kellogg.northwestern.edu/article/measuring-innovation-patents-productivity

Wang, T., & Zatzick, C. D. (2019). Human capital acquisition and organizational innovation: A temporal perspective. *Academy of Management Journal*, *62*(1), 99–116.

Wangrow, D. B., Schepker, D. J., & Barker, V. L. (2015). Managerial discretion: An empirical review and focus on future research directions. *Journal of Management*, *41*(1), 99–135.

Wiersema, M. F., & Bantel, K. A. (1992). Top management team demography and corporate strategic change. *Academy of Management Journal*, *35*(1), 91–121.

Withers, M. C., Ireland, R. D., Miller, D., Harrison, J. S., & Boss, D. S. (2018). Competitive landscape shifts: The influence of strategic entrepreneurship on shifts in market commonality. *Academy of Management Review*, *43*(3), 349–370.

Xu, F., Wu, L., & Evans, J. (2022). Flat teams drive scientific innovation. *Proceedings of the National Academy of Sciences*, *119*(23), e2200927119.

Zhang, Y., & Rajagopalan, N. (2010). Once an outsider, always an outsider? CEO origin, strategic change, and firm performance. *Strategic Management Journal*, *31*(3), 334–346.

Zhu, D. H., Jia, L., & Li, F. (2022). Too much on the plate? How executive job demands harm firm innovation and reduce share of exploratory innovations. *Academy of Management Journal*, *65*(2), 606–633.

Zhu, D. H., & Shen, W. (2016). Why do some outside successions fare better than others? The role of outside CEOs' prior experience with board diversity. *Strategic Management Journal.*, *37*, 2695–2708.

Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, *13*(3), 339–351.

## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

**How to cite this article:** Harrison, J. S., Boivie, S., Stern, I., & Porac, J. (2024). Inventor CEO involvement and firm exploitative and exploratory innovation. *Strategic Management Journal*, *45*(11), 2227–2256. https://doi.org/10.1002/smj.3628