The Impact of Executive Board Member Characteristics on Firm Innovation: The Roles of R&D and Organizational Tenure

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Much of the current thinking on board composition suggests that the presence of executive directors as internal board members is detrimental to a firm's innovation. Our intention in this research paper is to grant greater nuance to this relationship. Specifically, we examine whether factors that give an executive director greater knowledge regarding the firm's innovative capabilities (involvement in R&D and their organizational tenure) act to influence firm-level innovation. Using a dataset of 300 firms from three R&D intensive industries spanning a 6-year period, we find that these two characteristics serve to offset the negative effects of executive directors on innovation. Our findings offer enhanced guidance to scholars and practitioners who are concerned about the presence of insiders on boards of directors.

Keywords:executive directors, board independence, innovation and behavioral characteristics

INTRODUCTION

As innovation becomes more critical for overall firm success (Bustinza *et al.*, 2019; Cumming, 1998), a growing interest has emerged regarding the impact of board governance on a firm's level of innovation (Sarto and Saggese, 2022; Sena *et al.*, 2018; Sierra-Moran, Cabeza-Garcıa and Gonzalez-Alvarez, 2022). Of particular concern has been the role of insider directors, as less independent boards (i.e., those with greater numbers of insider directors) are thought to be more accountable to firm management than shareholders. Indeed, recent studies have supported the idea that innovation suffers in firms with higher numbers of executive directors, defined as executives who serve on their organizations' board (Bednar, 2012; Jiraporn *et al*., 2018; Sena *et al*., 2018). Specifically, such boards have been found to invest less in risky innovation projects that yield high long-term returns (Attia *et al.*, 2021; Sena *et al.*, 2018). Moreover, firms with low board independence are found to be less diligent in monitoring executives' innovation decision-making (Andres and Vallelado, 2008; Attia *et al.*, 2021; Westphal, 1998).

As part of the top management team and the board of directors, executive directors hold unique positions within their organizations that grant them access to firm internal knowledge and the board of directors' long-term plans. While the literature suggests that the presence of executive directors (as internal board members) can diminish a firm's innovation, it has tended to look at executive directors as a homogeneous group. Hence, past studies have assumed that executive director board members similarly approach innovation decisions due to having similar knowledge, motivations, and interests (Gu and Zhang,

2017; Moussa, 2019; Sierra-Morán *et.al*, 2024; Xu and Bai, 2019). However, this is likely not the case. Although the current literature is rich with scholarly work that has advanced our understanding of the impact of executive directors on firms' innovation (Balsmeier *et al.*, 2017; Jiraporn *et al.*, 2018), we still have unanswered questions about how heterogeneity in executive directors' backgrounds may differentially influence both their knowledge of and preferences for innovation. Specifically, there is still a need to unpack how access to certain types of knowledge and information granted by executive directors' background characteristics (e.g., R&D involvement and organizational tenure) can impact the currently accepted negative relationship between executive directors and firm innovation. We suggest that some executive directors can and do hold valuable knowledge about the organization, its innovations, etc., that could be helpful to a board's decision-making regarding innovation. For example, executive directors have been found to act as internal information sources, granting firm-specific insights to the board (Paulus and Lejeune, 2013). This is because executive directors have both high access to information and a strong understanding of their functional areas, both of which make them potential sources of valuable information (Kunisch *et al.*, 2022; Menz, 2012). Finally, this access to firm-specific information allows executive directors to become more engaged in guiding a firm's board, unlike external members who are more concerned with monitoring (Attia *et al.*, 2021; Srinivasan *et al.*, 2018).

Thus, while in general, the presence of executive directors had been found to hurt a firm's level of innovation, there is reason to believe that when such directors possess knowledge of the firm and/or its innovative capabilities, this can help prevent the negative impacts associated with executive directors. For example, the literature suggests that directors involved in R&D exhibit different attitudes towards innovation, as such involvement grants them enhanced knowledge about innovation projects, making them significantly more aware of the risks (and rewards) that exploration poses to the firm (Bantel and Jackson, 1989; Kunisch *et al.*, 2022). Additionally, scholars have found that as executives' knowledge of the firm and its industries increases over time, so does their tolerance for innovation risk (Bergh, 2001). Thus, given the presence of executive directors on the board, we investigate the question of how these executive directors' possession of innovation and organizational knowledge impacts a firm's level of innovation.

Our findings have important implications for two areas of the management literature. First, the ideas advanced in this paper have rich implications for the literature on board composition (Ain *et al.*, 2021; Andres and Vallelado, 2008; Boivie *et al.*, 2016; Heubech and Meckl, 2023, Kao *et al.*, 2019; Westphal and Zajac, 2013). As stated, this literature currently holds that boards with a high proportion of executive directors, as insider directors, will lead to less firm innovation (Fama and Jensen, 1983; Kor, 2006; Steinbach *et al.*, 2017; Tanikawa and Jung, 2019). We build on this literature by proposing access to information due to R&D involvement and tenure as a mechanism that mitigates and weakens the negative relationship between executive directors and firms' innovation. We suggest that executive directors who are involved in R&D have developed a strong understanding of their firm's innovation needs and specific knowledge that make them both comfortable dealing with high level of uncertainty, experienced with highly innovative projects, and capable of accurately judging which innovation initiatives have high potential of success. Similarly, we argue that executive directors with extended tenure with their firms have internal and external knowledge that allow them to bring innovative insights to their organizations. Bringing behavioral characteristics to this discussion provides a new theoretical conceptualization of what motivates executives to act in the best interest of shareholders when they serve as board members. By doing so, we provide insights on how firms can handle the tension between, on one hand, their desire to acquire internal insights by appointing executives as directors, and on the other the goal of protecting shareholders' interests.

Second, the existing research in corporate governance has focused almost exclusively on board independence as a strategy to ensure that boards act according to shareholders' best interests when making innovation decisions (Jiraporn *et al.*, 2018; Sena *et al.*, 2018). However, this focus does not consider instances when a firm needs to have executives as board members to ensure access to internal information and to deepen a board's understanding of firms' internal operations. In this paper, we investigate under what conditions more executive directors will be beneficial for firm innovation. We expand on this literature by offering a unique behavioral perspective that suggests executive directors will act more like external directors regarding innovation decisions when they are either involved in R&D functions or when they hold

long tenure with their organizations. By doing so, we integrate a knowledge-based view (Dahlander *et al.*, 2016; Drees and Heugens, 2013; Grant, 1996) and agency theory (Fama and Jensen, 1983; Kor, 2006; Steinbach *et al.*, 2017; Tanikawa and Jung, 2019) mechanisms to explain the heterogeneity in firm decision making related to internal innovation. We suggest having specific knowledge about a firm's R&D and/or its capabilities can alter the risk preferences of executive directors, thereby influencing their decisions pertaining to a firm's pursuit of innovation.

In the remainder of this paper, we provide an overview of the existing literature on internal board members (i.e., the presence of executive directors). Specifically, we focus on the current understanding of the relationship between board independence and firm performance, with particular attention to firm innovation. By doing so, we untangle the different dimensions of organizational innovation and how it is impacted by board independence. Following this, we integrate mechanisms from agency theory and the knowledge-based view to develop hypotheses testing the impact of executive director involvement in R&D and their organizational tenure on the executive director-firm innovation relationship. Lastly, we test our framework using panel data of 300 US-based publicly traded firms from three R&D intensive industries over six years.

LITERATURE REVIEW

Board independence reflects the proportion of independent directors on the board (Li and Song, 2013, Younas *et al.*, 2019), who are defined "as someone who has never worked at the company or any of its subsidiaries or consultants, is not related to any of the key employees, and does not/did not work for a major supplier or customer" (Ravina and Sapienza, 2010: p. 962). In other words, an independent director has no direct or indirect relation to the focal firm (Crespí-Cladera and Pascual-Fuster, 2014). On the other hand, internal directors are known for having various relations with the focal firm, resulting in the current perspective that internal directors are beholden to firm management rather than shareholders (Bednar, 2012; Jiraporn *et al*., 2018; Sena *et al*., 2018). As a result, board independence is considered a highly recommended corporate governance mechanism to ensure the effectiveness of a board in monitoring and guiding the firm's executives (Kang *et al.*, 2007). Due to the significant role played by boards of directors, as monitors and mentors to executives' decisions (Attia *et al.*, 2021; Daily *et al.*, 2003; Hillman *et al*., 2009), the literature warns against boards with high levels of internal directors, suggesting that board independence is a critical mechanism to ensure a board's effectiveness in monitoring and influencing executives' behaviors in order to safeguard shareholders' interests. Hence, board independence represents an instrument to ensure that board decisions are in line with shareholders (Hersel *et al.*, 2019).

This literature also suggests that lack of board independence poses a considerable danger to firm performance (Zahra and Pearce, 1989; Kang *et al.*, 2007; Westphal, 1998; Younas *et al.*, 2019; Zahra and Pearce, 1989). Internal directors were found to be less likely to rectify overconfident CEO decisions, resulting in better decision making than independent directors (Banerjee *et al.*, 2015). In addition, internal board members are less likely to align executives' incentives with shareholder interests than do independent board members, which can impact how executives make decisions (Duru *et al.*, 2016; Kang & Zaheer, 2018; Mishra and Nielson, 2000; Westphal and Zajac, 2013). Board lack of independence was also found to hurt how investors evaluate firm value and performance. Due to their weakened monitoring, having internal directors is considered a signal of lower levels of transparency (Ajinkya *et al.*, 2005; Ferreira *et al.*, 2011; Hsu *et al.*, 2021). In a similar vein, independent directors were found to decrease the level of unhealthy risk taking more than internal directors (Akbar *et al.*, 2017; Younas *et al.*, 2019). Lastly, the literature suggests that board independence has nuanced ramifications on firms' ambidextrous innovation (Rejeb *et al.*, 2020).

Despite the critical role of independent board members, appointing internal board members has been considered necessary in some instances. For example, Fama and Jensen (1983) argue that firms need internal information to assess and monitor different initiatives. However, this internal information might be costly to acquire without internal board members. Hence, internal directors become necessary and influential as a credible internal information source. But as stated above, the presence of internal board

members has been generally associated with adverse firm-level effects (Drees and Heugens, 2013; Jiraporn *et al.,* 2018; Sena *et al.,* 2018). Indeed, regarding innovation, Sena *et al.,* (2018) found that internal board members weakens firm innovation by causing the firm to invest in less risky (and thus less profitable) innovation projects, putting them at odds with the interests of shareholders. However, current research has not considered how executive directors' access to different types of knowledge may impact their decision-making regarding innovation. Building on Fama and Jensen's (1983) argument, we suggest that having information access through R&D involvement and organizational tenure may alter an executive director's preferences toward firm innovation. We turn to this question in the next section.

EXECUTIVE DIRECTORS AND FIRM INNOVATION

Executive directors are part of the board of directors and the top management team. As a result, they are expected to perform the duties of both positions to the best of their ability. In this unique position, they have the chance to execute on strategic decisions related to firms' agenda on internal innovation as part of the executive team while authorizing such decisions on behalf of shareholders as part of the board of directors. Examples of innovation-related decisions executive directors are expected to make as part of the board are evaluating and selecting which projects to invest in from a pool of innovative ideas (Berg, 2016). Executive directors may also be responsible for establishing managerial processes and practices that serve as a base for selecting incremental over radical innovation (Benner and Tushman, 2002, Andres and Vallelado, 2008; Berg, 2016; Boone *et al.,* 2019).

Due to executive directors' unique position that grants them the opportunity to participate in setting a firm long term innovation decision while executing strategic decisions, executive directors may have an enduring impact on firm innovation. Boards of directors have been shown to influence innovation either by facilitating an organizational context that fosters firm innovation (Steiber and Alange, 2013; Zona *et al.,* 2013) or by bringing wide access of information in the form of guidance and advice (Dahlander *et al.,* 2016; Hillman *et al.,* 2009; Westphal, 1998). As opposed to managers' interests more consistent with short-term gains, shareholders' interests are more aligned with innovative projects that can yield high returns in the long term (Hoskisson *et al.,* 2002). As the proportion of internal directors increases, executive directors become more likely to put up barriers against projects that are not aligned with their short-term interests, even if these projects are in the long-term interest of shareholders, thus resulting in the pursuit of less innovative projects (Pollock *et al.,* 2002). On the one hand, shareholders, with diversified portfolios have a higher tolerance for risky investments compared to the executive team. On the other hand, executive directors, due to their role in the executive team, may prefer to invest in less innovative projects that result in short-term gains as opposed to long-term gains (Baysinger *et al.,* 1991; Eisenhardt, 1989; Fama and Jensen, 1983; Wright *et al.,* 2007), which results in limited innovation output (Xu, Wang and Liu, 2020).

In addition, the potential negative influence of executive directors on firms' internal innovation is enhanced by restricted information access (Chen *et al.,* 2015). Executive directors as internal directors have limited access to external knowledge. The knowledge-based view entails that firms with wide and diverse information access are more likely to produce innovation (Grant, 1996). One of the methods to widen firms' information access is by appointing external board members (Dahlander *et al.,* 2016; Drees and Heugens, 2013; Hillman *et al.,* 2009; Provan, 1980). However, having executive directors (who are internal board members) may result in limited external information access. Executive director access to information may be myopic because it is too focused on current operations, making them more likely to bring fewer new ideas and less rich information to the board. Scholars suggest that the increase of executive directors is more likely to lead firms to miss innovative opportunities outside their firm's boundaries. Thus, given what we know about the negative effects of executive directors, our baseline hypothesis is:

Hypothesis (H1): *There will be a negative relationship between the proportion of executive directors on a firm's board and the level of firm innovation.*

Boundary Conditions

While executive directors are generally thought to hurt innovation, we argue that executive directors' knowledge and motivations will vary depending on their position in the organization. We suggest that an executive director with a position granting access to innovation-related knowledge or deep understanding of a firm's specific knowledge and environment will exhibit different innovation preferences. Specifically, we argue that executive involvement in a firm's R&D and their tenure with an organization can alter their approach to innovation decisions. For example, the literature suggests that firms benefit more in innovation from directors with experience close to a firm's focal knowledge (Attia *et al.,* 2021; Carpenter and Westphal, 2001). Due to their access to information and strong understanding of their functional area, executive directors can provide internal insights to assist the board in their monitoring and guidance roles (Kunisch *et al.*, 2022; Menz, 2012; Sarto and Saggese, 2022).

Additionally, internal directors' tenure may increase their tolerance to risk due to their increased understanding of their firms and industries (Bergh, 2001; Henderson *et al.*, 2006; Sanders, 2001). Building on the above, we argue that R&D involvement and tenure are two characteristics that can mitigate the negative impact of executive directors on firm innovation. In other words, we theorize that the negative impact can be alleviated by appointing executive directors with similar motivations to firm shareholders. This can be done by deliberately selecting executives involved in R&D or executives who have been with their firms for long tenures to serve as executive directors.

Executive Directors' Involvement in R&D. We suggest that executive director involvement in R&D is an important factor that may mitigate the negative impact of executive directors on firm internal innovation (Helfat and Martin, 2015; Paulus and Lejeune, 2013). An increasing number of firms, especially in knowledge-intensive industries, have executives exclusively involved in R&D and innovation (Katila *et al.*, 2017). Scholars suggest that executives' work experience shapes their cognition and attitude toward innovation (Bantel and Jackson, 1989; Di Guardo and Harrigan, 2016; Wal *et al.,* 2019). For example, executives who are involved in R&D are more likely to dedicate greater resources to R&D compared to those who are not in direct contact with this area, as they are likely evaluated on the performance of their R&D divisions and thus, their interests are aligned with pursuing innovation (Eisenhardt, 1989; Wal *et al.*, 2019). Additionally, Menz (2012) found that executives actively involved with innovation-related functions – being the Chief Innovation Officer for example – are more likely to make decisions that favor exploratory or highly innovative projects over those that promote small product improvements. This can be explained by R&D executives' access to information that enables them to be more confident and comfortable with the risks inherent in highly innovative projects. Additionally, R&D executives are more likely to be evaluated based on a firm's innovation performance, aligning their interests with those of shareholders.

Based on the above arguments, we suggest appointing R&D executives as internal directors may mitigate the negative relationship between executive directors and firm innovation. Executive directors who are involved in R&D are expected to have access to internal information related to the firm's innovation projects, making them more comfortable and capable of assessing the magnitude of the financial risks. Hence, executive directors' experience with their firm's R&D can make them more tolerant of innovation risks. Additionally, executive directors who are involved in R&D may deploy available knowledge and information to make decisions that are favorable towards firm innovation and thus more accepting of innovation projects in general. Therefore, we hypothesize that having executive directors involved in R&D weakens the negative relationship between executive directors and firm innovation.

Hypothesis (H2): *Executive director involvement in R&D will weaken the negative relationship between the proportion of executive directors and firm innovation.*

Executive Director Tenure. Scholars have also identified an executive's tenure with an organization as a factor influencing a firm's innovation (Elenkov *et al.*, 2005; Meyer and Goes, 1988). Executives with the longest tenure have an amplified impact on their firms since they have firm specific knowledge that helps in deciding on the allocation of firm resources and on whether to invest in innovative projects (Chen, 2013; Musteen *et al.*, 2010). Scholars suggest that as an executive's tenure increases with their firm, he or she

becomes more able to take on innovative projects due to the increase in their knowledge of the firm and its environment (Chen, 2013; Jukka, 2020; Souder *et al.*, 2012; Tanikawa and Jung, 2019). We suggest this increased knowledge of firm capabilities, customers, competitors, and the like can help offset the negative effects of executive directors. This time with the firm grants them enhanced information access, knowledge of what works and what does not, and greater insight into the true risks associated with innovation projects. Moreover, research shows that as executive tenure increases, their accumulated knowledge increases, which positively impacts firm innovation (Berman *et al.*, 2002; Souder *et al.*, 2012; Tihanyi *et al.*, 2000; West and Anderson, 1996). Therefore, we suggest that executive director tenure enhances their willingness to invest in innovation, weakening the negative impact of their presence on a firm innovation.

Hypothesis (H3): *Executive director organizational tenure weakens the negative relationship between the proportion of executive directors and firm innovation.*

METHODS

Sample and Research Context

We test our hypotheses using panel data on U.S.-based, publicly traded firms from three R&D intensive industries: pharmaceuticals (SIC 283), telecommunications (SIC 481), and computer programming (SIC 737). Our data covers six years from 2006 to 2011, during which many firms started limiting the proportion of executive directors. This context is suitable since these are knowledge intensive industries that require continuous knowledge development through innovation to maintain a competitive advantage. In examining the software industry, we find that offering a wide variety of products requires continuous innovation (Cottrell and Nault, 2004). The same applies for pharmaceutical and telecommunication firms. Our final sample size is a panel of 300 observations. Some data loss occurred due to the incompleteness of executive directors' data in the ExecuComp database, as reporting this information is not mandatory. The USPTO, ExecuComp WRDS Compustat, and SDC databases were all used in this study.

Dependent Variable

Firm innovation was measured using patent data, which is a widely accepted proxy for this variable in the management literature (Sierra-Moran, Cabeza-Garcıa, and Gonzalez-Alvarez, 2022; Wang and Wang, 2023). We operationalized *firm innovation* as a weighted patent count, the average count of citations per patent. A weighted patent count considers the impact and the quality of new innovative ideas that a firm produces yearly – as reflected by considering citations for each patent (Correa and Ornaghi, 2014). Firm weighted patent count is rounded to the nearest integer since firms cannot have a fraction of a patent. Since this is the dependent variable, it is lagged by one year. The dependent variable is computed as follows:

Firm's Weighted Patent Count (t)= Firm's Total Number of Citations (t) / Firm's Total Number of Patents(t) (1)

Independent Variable

Board independence (proportion of executive directors) was measured as the ratio of executive directors to the total number of board members at the same firm. This ratio reflects the proportion of executives who are board members in their firms during the same year. We excluded dual CEOs to avoid any confounds that may influence firm innovation. This variable is calculated by dividing the total number of executive directors by board size for each firm for every year *t* (Bantel and Jackson, 1989; Srinivasan et al., 2018).

$$\textit{Executive board members proportion (t)} = \frac{Total\ number\ of\ executive\ board\ members(t)}{Total\ number\ of\ board\ members(t)} \quad (2)$$

Moderators

Director Involvement in R&D reflects whether there is at least one executive director on the board with deep knowledge of the risks and operations of a firm's R&D department. Executive director involvement in R&D was measured as a dichotomous variable. Firms that have at least one executive director dedicated to R&D for year *t* are coded as "1," otherwise "0." Executive titles recognize dedication to firm innovation. Any executive director with "R&D," "Innovation," "Information," "Research and Development," or "New Product Development" in their executive title was considered as a dedicated executive to their firm's innovation. Finally, *Executive Director Tenure* reflects the average number of years spent by each executive director *k* at the current firm for every year *t*. This measure was developed based on the work by Musteen and colleagues (2010).

$$Executive\ Board\ Members\ Tenure(t) = \frac{\sum_{k=0}^{n} Executive\ board\ members\ tenure}{Number\ of\ executive\ board\ members\ in\ year\ t} \quad (3)$$

Control Variables

We control for *year effects* using dummies for different years. To account for differences in innovation dynamics at the industry level, we control for *innovation concentration*, which reflects whether an industry's level of innovation is dominated by few firms or many. We calculate this variable by adding the top four firms in a number of patents in each SIC code for each year *t* and dividing this number by the total number of patents in each industry for every year *t*. *Firm size, firm age, total cash, market value, and R&D intensity* are incorporated in the analysis as well, since literature suggests that these variables may impact firm-level innovation (Ahuja and Katila, 2001) and that older firms can be more efficient compared to younger ones because they have more experience and established routines and processes (Liao and Wu, 2011), which may lead older firms to less innovation. Firm market value is a measure of financial performance and total cash reflects a firm's ability to invest in internal innovation.

Additionally, we controlled for *alliance experience* due to its impact on firm innovation (Hess and Rothaermel, 2011). Consistent with Kumar and Zaheer (2019), this variable was calculated using a three-year moving window of a firm's proportion of alliances compared to the rest of the industry. The literature suggests that firms engage in alliances every three to five years (Kumar and Zaheer, 2019), hence the three-year moving window. We included two team-level controls – *average executive age* and *executive team size* – as both have been found to impact a firm's level of innovation (Alexiev *et al.,* 2010; Davidson III *et al.,* 2007). We also controlled for *executive board members' relative stock compensation* by dividing executive board members' stock compensation by non-board executives' stock compensation. This was done to account for the effects of any difference in stock compensation between executive board members and non-board executives. Lastly, we controlled for *CEO tenure* to account for its influence on innovation (Musteen *et al.,* 2010). Three controls (executive board members' relative compensation, cash and market value) were logged to follow a normal distribution.

Analytical Procedures

We used fixed-effects Poisson regression. Poisson regression is appropriate to test our model since we measure firm innovation using weighted patent counts, which is a count variable. Moreover, our dependent variable satisfies the Poisson distribution assumption of independent observations (Shen and Huang, 2008; Treiman, 2009). We performed the Hausman test to confirm that the fixed-effects Poisson model is appropriate to test the proposed model since we believe that fixed effects have an influence in the context of our research question. The results were significant, confirming a significant difference between using random effects and fixed effects models. Lastly, we test for multicollinearity. Testing for variance inflation factors in our variables, the results show variance inflation that is less than four, confirming that our model does not have multicollinearity issues (Alin, 2010; Lavery *et al.,* 2019; Mansfield and Helms, 1982).

RESULTS

In Table 1, we report descriptive statistics for all variables. In Table 2, we include the results of five Poisson regression models in addition to the base model. In Model 1, we test and find support for Hypothesis 1 (β = -0.236, p = .018). This finding supports our baseline hypothesis that increasing numbers of executive directors would negatively affect a firm's innovation. In Model 3, we examine the second hypothesis by testing for the moderating effect of executive director R&D involvement on the executive director-firm innovation relationship. The results in Model 3 show support for the second hypothesis (β= 4.036, p = .013) which suggest that firms with an R&D executive director are expected to produce innovation 4.036 times more than firms with no R&D executive directors, assuming other factors are held constant. Furthermore, a graphical depiction shows that firms with executive director R&D involvement are less impacted by the negative influence of executive board members on firm innovation in comparison to firms that do not have executive directors who are involved in R&D (see Figure 1). Thus Hypothesis 2 is supported.

In Model 4, we test the moderating role of executive director tenure on the relationship found in Hypothesis 1. The results are significant (β= 0.024, p = .092), suggesting that a unit increase in executive director tenure is associated with an increase in firm innovation by a factor of 0.024, assuming other variables are held constant. Consistent with our theorizing, a graph of this interaction shows that firms with a high proportion of executive board members and high executive director tenure have greater innovation than firms with high proportions of executive board members and low executive tenure (see Figure 2). Thus, Hypothesis 3 is supported. Our last model (Model 5) is the full model and supports all three hypotheses. Moreover, we performed two robustness tests that supported our model.

TABLE 1
DESCRIPTIVE TABLE

Variables	Mean	*s.d.*	min	*max*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Weighted Patent Count	11.053	20.688	0.000	360.000	1.000														
2 Executive Directors Proportion	0.230	0.269	0.000	0.370	-0.052	1.000													
3 Executive Directors' R&D involvment	0.013	0.113	0.000	1.000	-0.024	-0.016	1.000												
4 Executive Directors' Tenure	9.216	7.419	0.706	39.000	**-0.179**	**0.115**	0.080	1.000											
5 CEO Tenure	7.815	7.465	0.000	39.000	-0.051	0.071	0.050	**0.308**	1.000										
6 Executive Average Age	49.655	4.191	38.167	62.000	**-0.281**	0.047	0.067	**0.337**	0.053	1.000									
7 Executive Team Size	5.657	1.636	2.000	12.000	0.073	**0.221**	-0.072	-0.039	-0.050	0.038	1.000								
8 Exectuives' Relative Stock Compensation	1.340	2.163	-5.626	11.157	**0.150**	**0.213**	0.067	0.076	**0.540**	**-0.210**	-0.011	1.000							
9 Firm Size	15.438	49.178	0.000	433.000	**-0.140**	-0.057	-0.055	**0.525**	-0.045	**0.268**	-0.028	**-0.146**	1.000						
10 Firm Age	26.976	22.875	1.000	136.000	**-0.230**	-0.052	-0.069	**0.387**	**-0.165**	**0.388**	0.048	**-0.238**	**0.418**	1.000					
11 R&D Intensity	1.438	18.395	0.000	496.620	**-0.155**	-0.091	**0.177**	-0.027	0.107	0.133	-0.026	-0.034	-0.082	-0.001	1.000				
12 Market Value (ln thousands, ln)	7.661	1.920	0.000	276428.000	**-0.248**	-0.099	-0.057	**0.243**	-0.112	**0.270**	0.064	-0.047	**0.568**	**0.422**	-0.123	1.000			
13 Alliance Experience	0.369	0.360	0.000	1.000	**-0.228**	0.029	**0.208**	0.104	-0.070	**0.312**	**0.149**	-0.027	0.077	**0.259**	**0.138**	**0.368**	1.000		
14 Cash (ln thousands, ln)	5.323	1.754	0.000	16163.000	-0.273	0.095	-0.052	**0.228**	-0.124	**0.288**	0.049	**-0.052**	**0.515**	**0.492**	**-0.133**	**0.878**	**0.326**	1.000	
15 Innovation Concentration	0.660	0.078	0.603	0.987	-0.131	**-0.146**	-0.065	0.064	0.007	**0.187**	0.066	**-0.125**	**0.298**	-0.025	0.010	**0.196**	-0.070	**0.165**	1.000

p < 0.05 for correlations in bold

TABLE 2
REGRESSION ANALYSIS RESULTS

DV: Firms' Internal Innovation		Base model	Model 1	Model 2	Model 3	Model 4	Model 5
Constant		4.956 ***	4.832 ***	4.920 ***	4.772 ***	4.868 ***	4.816 *
		0.299	*0.299*	*0.306*	*0.300*	*0.307*	*0.307*
Predictor variables							
Executive Directors' Proportion	**H1 (-)**		-0.236 *		-0.252 *	-0.425 **	-0.446 **
			0.099		*0.099*	*0.154*	*0.153*
Interactions							
Executive Directors' Involvement in R&D				0.682 **	-0.336		-0.281
				0.236	*0.476*		*0.477*
Executive Directors' Proportion × Executive Directors' Involvement in R&D	**H2 (+)**				4.037 *		3.880 *
					1.624		*1.626*
Executive Directors' Tenure				0.006		0.000	-0.002
				0.011		*0.011*	*0.012*
Executive Directors' Proportion × Executive Directors' Tenure	**H3 (+)**					0.023 †	0.024 †
						0.014	*0.014*
Controls							
CEO Tenure		0.010	0.011	0.008	0.011	0.015	0.011
		0.009	*0.009*	*0.009*	*0.009*	*0.009*	*0.009*
Executive Average Age		-0.013	-0.012	-0.012	-0.009	-0.015	-0.011
		0.017	*0.017*	*0.017*	*0.017*	*0.017*	*0.017*
Executive Team Size		0.045 *	0.050 *	0.048 *	0.057 **	0.045 *	0.054 *
		0.021	*0.021*	*0.021*	*0.021*	*0.021*	*0.021*
Executive Directors' Relative Stock Compensation (Ln)		-0.045 *	-0.041 *	-0.045 *	-0.036 †	-0.043 *	-0.090 †
		0.020	*0.020*	*0.020*	*0.020*	*0.020*	*0.020*
Firm Size		-0.009 *	-0.009 *	-0.009 *	-0.009 *	-0.010 *	-0.011 **
		0.004	*0.004*	*0.011*	*0.004*	*0.004*	*0.044*
Firm Age		0.178 †	0.193 *	0.182 †	0.197 *	0.194 *	0.197 *
		0.093	*0.094*	*0.093*	*0.094*	*0.094*	*0.095*
R&D Intensity		-0.056	-0.057	-0.053	-0.062	-0.059	-0.063
		0.099	*0.099*	*0.099*	*0.100*	*0.100*	*0.100*
Market Value (Ln)		-0.165 **	-0.124 †	-0.153 **	-0.100	-0.121 †	-0.097
		0.064	*0.066*	*0.064*	*0.066*	*0.066*	*0.066*
Alliance Experience (3 years moving window)		0.455 ***	0.437 ***	0.428 ***	0.403 **	0.429 ***	0.392 ***
		0.116	*0.116*	*0.117*	*0.116*	*0.116*	*0.118*
Cash (Ln)		-0.089	0.088	-0.098 †	-0.104 †	-0.091	-0.107 †
		0.057	*0.057*	*0.057*	*0.057*	*0.056*	*0.057*
Innovation Concentration		-1.100	-1.477	-0.533	-1.360	-1.430	-1.277 ***
		1.719	*1.715*	*1.727*	*1.732*	*1.717*	*1.730*
Year		Included	Included	Included	Included	Included	Included
Wald Chi2		492.060	498.890	500.750	510.900	501.410	513.300
Prob > Chi2		0.000	0.000	0.000	0.000	0.000	0.000

Poisson panel regression (standard error reported *italic*)
N: 300 observations.
Significance levels: † p < 0.1;* p < 0.05; ** p < 0.01; *** p < 0.001

FIGURE 1
EXECUTIVE DIRECTOR R&D INVOLVEMENT INTERACTION WITH LOW AND HIGH EXECUTIVE DIRECTOR PROPORTION

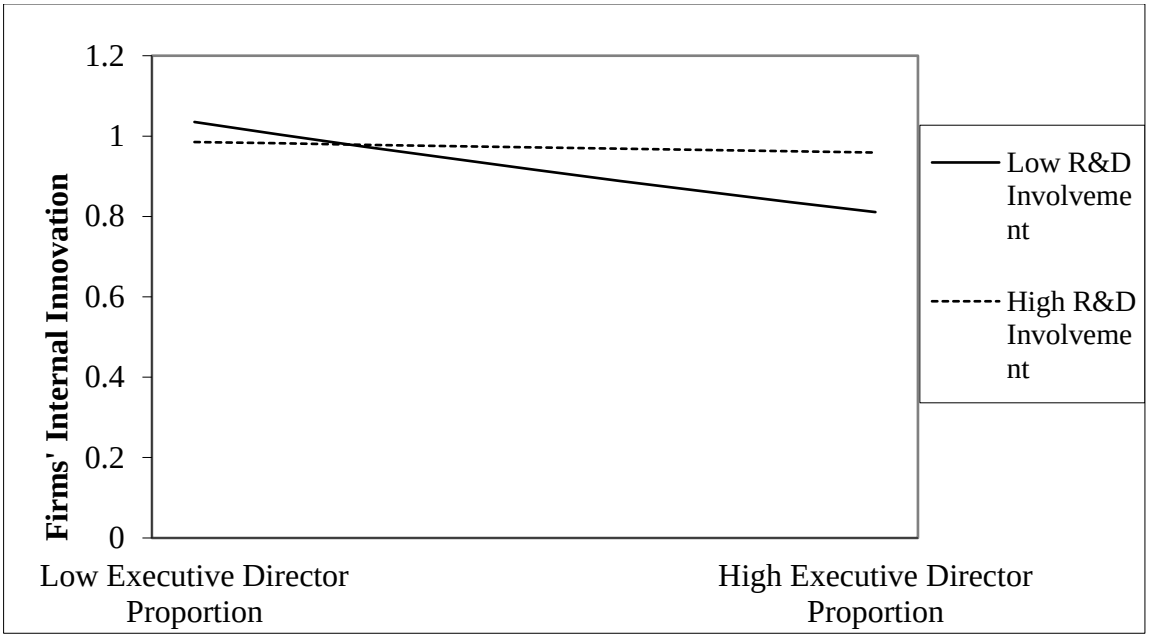
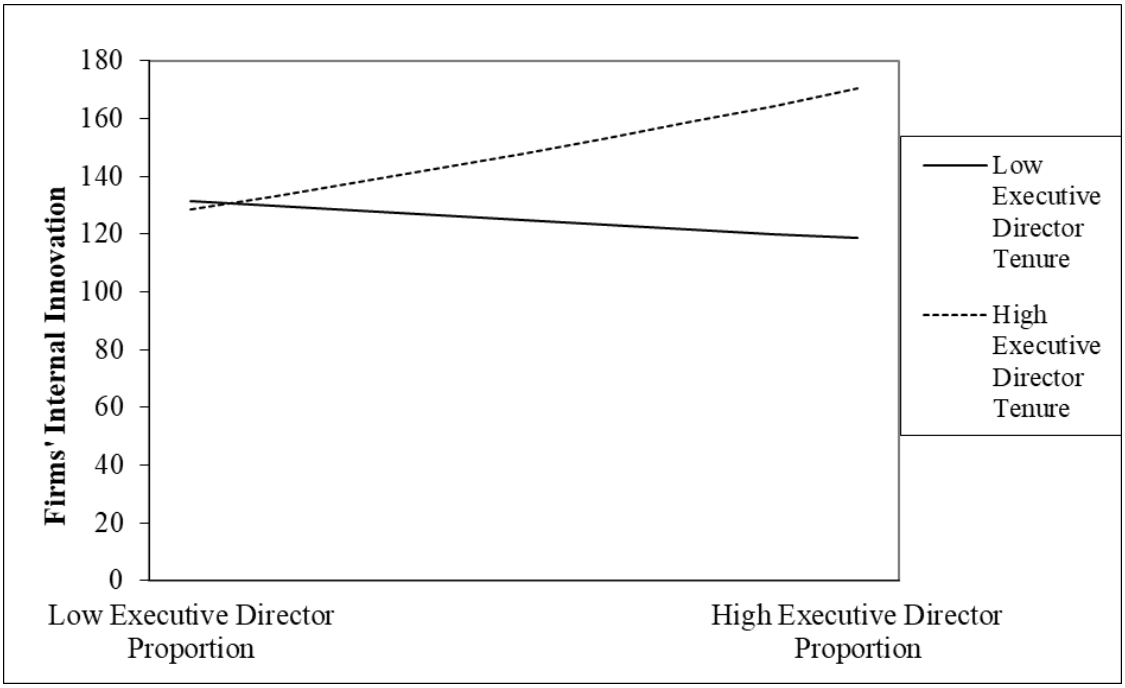


FIGURE 2
EXECUTIVE DIRECTOR TENURE INTERACTION WITH LOW AND HIGH EXECUTIVE DIRECTOR PROPORTION



To address any concerns related to reverse causality, we did test for endogeneity. There are different ways to examine whether reverse causality impacts investigated relationships. In this paper, we tested for endogeneity using two different methods. In the first method, we tested for reverse causality by rerunning our model with all variables in the same year, without lagging the dependent variable. The results (Table 3) did not support my model, suggesting no concerns of reverse causality in the model.

TABLE 3
REGRESSION RESULTS FOR SUPPLEMENTAL ANALYSIS FOR REVERSE CAUSALITY

DV: Firms' Innovation		Base model	Model 1	Model 2	Model 3	Model 4	Model 5
Constant		2.188 *	2.236 *	2.115 *	2.280 **	2.074 *	2.118 *
		1.097	*1.087*	*1.101*	*1.081*	*1.100*	*1.096*
Predictor variables							
Executive Directors' Proportion	H1 (-)		-0.392		-0.407	-0.120	-0.104
			0.220		*0.222*	*0.380*	*0.381*
Interactions							
Executive Directors' Involvement in R&D				-0.294	-0.404		-0.424
				0.374	*0.608*		*0.615*
Executive Directors' Proportion × Executive Directors' Involvement in R&D	H2 (+)				0.230		0.273
					2.189		*2.190*
Executive Directors' Tenure				-0.008		-0.003	-0.001
				0.374		*0.011*	*0.011*
Executive Directors' Proportion × Executive Directors' Tenure	H3 (+)					-0.023	-0.026
						0.028	*0.028*
Controls							
CEO Tenure		-0.011	-0.011	-0.009	-0.011	-0.009	-0.010
		0.009	*0.009*	*0.010*	*0.009*	*0.010*	*0.010*
Executive Average Age		0.008	0.012	0.012	-0.005	0.015	0.016
		0.018	*0.018*	*0.019*	*0.003*	*0.019*	*0.019*
Executive Team Size		-0.023	-0.009	-0.027	-0.012	-0.010	-0.013
		0.043	*0.043*	*0.043*	*0.043*	*0.043*	*0.042*
Executive Directors' Relative Stock Compensation (Ln)		0.025	0.034	0.029	0.036	0.038	0.039
		0.030	*0.030*	*0.030*	*0.030*	*0.030*	*0.030*
Firm Size (ln)		0.027	0.018	0.030	0.015	0.024	0.020
		0.067	*0.067*	*0.068*	*0.067*	*0.067*	*0.068*
Firm Age		-0.005	-0.005	-0.004	-0.005	-0.004	-0.004
		0.003	*0.003*	*0.003*	*0.003*	*0.003*	*0.003*
R&D Intensity		-0.210	-0.213	-0.175	-0.178 *	-0.215	-0.178
		0.228	*0.229*	*0.230*	*0.237*	*0.229*	*0.238*
Market Value (weighted)		0.000	0.000	0.000	0.000	0.000	0.000
		0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Alliance Experience (3 years moving window)		-0.212	-0.244	-0.208	-0.225	-0.241	-0.219
		0.185	*0.184*	*0.186*	*0.184*	*0.184*	*0.184*
Cash (weighted)		-0.002	-0.002	0.000	0.000	0.000	-0.002
		0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Innovation Concentration		-0.754	-1.094	-0.816	-1.164	-1.104	-1.175
		1.215	*1.218*	*1.200*	*1.218*	*1.210*	*1.218*
Year		Included	Included	Included	Included	Included	Included
Wald Chi2		87.940	93.780	90.280	95.520	94.560	96.290
Prob > Chi2		0.000	0.000	0.000	0.000	0.000	0.000

Poisson panel regression (standard error reported *italic*)
N: 285 observations.
Significance levels: † p < 0.1;* p < 0.05; ** p < 0.01; *** p < 0.001

In the second method, we tested for endogeneity related to executive directors' involvement in R&D and tenure. To do so, we run two stage regression analysis using endogeneity covariant function in Stata. We also performed post estimation analysis that resulted in insignificant results confirming that both variables are exogenous.

TABLE 4
TWO STAGE REGRESSION RESULTS TO TEST FOR EXECUTIVE DIRECTORS' R&D INVOLVEMENT'S ENDOGENEITY

DV: Firms' Internal Innovation	
Constant	12.390 ***
Executive Directors Proportion	-0.760
Executive Directors R&D Involvement	-121.250
Durbin (Score) Chi 2	*1.050*
Wu-Hausman	*1.04*

Significance levels: † p < 0.1;* p < 0.05; ** p < 0.01; *** p < 0.001
Instruments: Executive Directors Cash Compensation, Executive Dire

TABLE 5
TWO STAGE REGRESSION RESULTS TO TEST FOR EXECUTIVE DIRECTORS' TENURE'S ENDOGENEITY

DV: Firms' Internal Innovation	
Constant	23.350 **
Executive Directors Proportion	4.440
Executive Directors Tenure	-1.337
Durbin (Score) Chi 2	*1.190*
Wu-Hausman	*1.18*

Significance levels: † p < 0.1;* p < 0.05; ** p < 0.01; *** p < 0.001
Instruments: Executive Directors Status, Executive Directors Cash Cc

Robustness Checks

Two robustness checks were performed to further examine our model and ensure the robustness of the results. Table 3 shows the results of the first robustness test. In the first robustness test, we test our model using negative binomial regression model. Negative binomial is an appropriate model to test our model since it requires a count dependent variable. This assumption is met in our dependent variable. We reran all the models. Rerunning Models 1, 3, 4 and 5 using negative binomial regression shows support for two out of three hypotheses. The first hypothesis, which tests for the impact of executive director proportion on firm innovation, is consistently supported in all the models. The interaction of executive director proportion and executive director involvement in R&D is supported in Models 3 and 5. However, the third hypothesis, which is the interaction of executive director proportion and executive average tenure, is not supported in any of the models.

Table 4 shows the results of second robustness test. In the second robustness test, we exclude executive directors with average tenure less than 1 year since they might not have had the time to acquire much knowledge of the organization. We reran all our models with the new sample using Poisson regression in this test. Running the second robustness test results in support for all three hypotheses. Although running robustness checks does not support all hypotheses, they strongly support the model. The negative impact of executive directors on innovation is prominent and significant based on the results of the original model and the robustness checks. Additionally, executive director involvement in R&D is consistently supported in all models in both robustness tests.

TABLE 6
REGRESSION RESULTS FOR THE FIRST ROBUSTNESS TEST

DV: Firms' Internal Innovation		**Base model**	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Constant		4.359 *	4.467 ***	4.287 ***	4.446 ***	4.593 ***	4.554
		1.081	*1.073*	*1.087*	*1.075*	*1.074*	*1.077*
Predictor variables							
Execytive Directors' Proportion	**H1 (-)**		-0.402 *		-0.426 *	-0.666 *	-0.670 *
			0.196		*0.197*	*0.300*	*0.298*
Interactions							
Executive Directors' Involvement in R&D				0.386	-0.404		-0.343
				0.318	*0.535*		*0.540*
Executive Directors' Proportion × Executive Directors' Involvement in R&D	**H2 (+)**				3.424 †		3.265 †
					1.871		*1.881*
Executive Directors' Tenure				-0.004		-0.008	-0.008
				0.011		*0.012*	*0.012*
Executive Directors' Proportion × Executive Directors' Tenure	H3 (+)					0.026 †	0.024
						0.021	*0.021*
Controls							
CEO Tenure		-0.011	-0.012	-0.011	-0.013	-0.011	-0.012
		0.009	*0.009*	*0.010*	*0.009*	*0.010*	*0.010*
Executive Average Age		-0.033 †	-0.033 †	-0.031 †	-0.031 †	-0.033 †	-0.031
		0.018	*0.018*	*0.018*	*0.018*	*0.018*	*0.018*
Executive Team Size		-0.004	0.010	-0.001	0.014	0.010	0.013
		0.035	*0.035*	*0.035*	*0.035*	*0.035*	*0.035*
Executive Directors' Relative Stock Compensation (Ln)		-0.002	0.010	-0.002	0.012	0.008	0.010
		0.027	*0.027*	*0.027*	*0.027*	*0.028*	*0.027*
Firm Size		0.002	0.002	0.002	0.002	0.002	0.002
		0.002	*0.002*	*0.002*	*0.002*	*0.002*	*0.002*
Firm Age		-0.002	-0.002	-0.001	-0.002	-0.002	-0.002
		0.004	*0.004*	*0.004*	*0.004*	*0.004*	*0.004*
R&D Intensity		-0.167 †	-0.166 †	-0.175 †	-0.187 †	-0.168 †	-0.189
		0.100	*0.100*	*0.101*	*0.103*	*0.100*	*0.103*
Market Value		0.000	0.000	0.000	0.000	0.000	0.000
		0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Alliance Experience (3 years moving window)		0.112	0.107	0.086	0.089	0.092	0.073
		0.170	*0.168*	*0.172*	*0.169*	*0.168*	*0.169*
Cash		0.000	0.000	0.000	0.000	0.000	0.000
		0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Innovation Concentration		-0.449	-0.701	-0.456	-0.770	-0.743	-0.807
		1.219	*1.218*	*1.226*	*1.220*	*1.222*	*1.223*
Year		Included	Included	Included	Included	Included	Included
Prob > Chi2		0.000	0.000	0.000	0.000	0.000	0.000

Poisson panel regression (standard error reported *italic*)
N: 322 observations.
Significance levels: † p < 0.1;* p < 0.05; ** p < 0.01; *** p < 0.001

TABLE 7
REGRESSION RESULTS FOR THE SECOND ROBUSTNESS TEST

DV: Firms' Internal Innovation		Base model	Model 1	Model 2	Model 3	Model 4	Model 5
Constant		4.787 ***	4.646 ***	4.736 ***	4.584 ***	4.682 ***	4.628 ***
		0.300	*0.301*	*0.307*	*0.301*	*0.308*	*0.308*
Predictor variables							
Executive Directors' Proportion	**H1 (-)**		-0.423 ***		-0.454 ***	-0.654 ***	-0.656 ***
			0.062		*0.063*	*0.123*	*0.124*
Interactions							
Executive Directors' Involvement in R&D				0.164	-1.252 ***		-0.938 **
				0.144	*0.373*		*0.379*
Executive Directors' Proportion × Executive Directors' Involvement in R&D	**H2 (+)**				5.020 ***		4.199 ***
					1.165		*1.182*
Executive Directors' Tenure				-0.028 ***		-0.031 ***	-0.029 ***
				0.004		*0.005*	*0.005*
Executive Directors' Proportion × Executive Directors' Tenure	**H3 (+)**					0.029 **	** 0.026
						0.011	*0.011*
Controls							
CEO Tenure		-0.026 ***	-0.028 ***	-0.017 ***	-0.028 ***	-0.019 ***	-0.020 ***
		0.003	*0.003*	*0.003*	*0.003*	*0.003*	*0.003*
Executive Average Age		-0.021 ***	-0.015 **	-0.013 **	-0.014 **	-0.008	-0.007
		0.005	*0.005*	*0.005*	*0.005*	*0.005*	*0.005*
Executive Team Size		0.108 ***	0.127 ***	0.116 ***	0.129 ***	0.128 ***	0.004 ***
		0.014	*0.014*	*0.014*	*0.014*	*0.014*	*0.000*
Executive Directors' Relative Stock Compensation (Ln)		0.086 ***	0.095 ***	0.097 ***	0.097 ***	0.104 ***	0.104 ***
		0.008	*0.008*	*0.009*	*0.008*	*0.009*	*0.009*
Firm Size		0.002 ***	0.002 ***	0.004 ***	0.002 ***	0.004 ***	0.004 ***
		0.001	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Firm Age		-0.007 ***	-0.007 ***	-0.005 ***	-0.007 ***	-0.006 ***	-0.006 ***
		0.001	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
R&D Intensity		-0.468 ***	-0.496 ***	-0.506 ***	-0.525 ***	-0.527 ***	-0.553 ***
		0.057	*0.058*	*0.058*	*0.059*	*0.058*	*0.059*
Market Value		0.000 **	0.000 **	0.000 **	0.000 **	0.000 ***	0.000 ***
		0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Alliance Experience (3 years moving window)		-0.661 ***	-0.681 ***	-0.679 ***	-0.669 ***	-0.673 ***	-0.677 ***
		0.069	*0.069*	*0.070*	*0.070*	*0.069*	*0.070*
Cash		0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
		0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Innovation Concentration		-1.454 ***	-1.803 ***	-1.918 ***	-1.818 ***	-2.205 ***	-2.191 ***
		0.334	*0.336*	*0.344*	*0.336*	*0.344*	*0.344*
Year		Included	Included	Included	Included	Included	Included
Prob > Chi2		0.000	0.000	0.000	0.000	0.000	0.000

Poisson panel regression (standard error reported *italic*)
N: 317 observations.
Significance levels: † p < 0.1;* p < 0.05; ** p < 0.01; *** p < 0.001

DISCUSSION AND CONCLUSION

The purpose of this paper was to add greater granularity to the scholarly work that focuses on board independence and its impact on firm-level innovation. While this literature suggests that executive directors are generally detrimental to innovation, our behavioral approach shows that certain executive characteristics (e.g., R&D involvement and organizational tenure) can and do obviate this relationship. The results show that firm innovation can benefit from boards with R&D executive directors, as they possess the understanding and information necessary for making these decisions. Thus, firms concerned with their level of innovation can be intentional in how they design the composition of their board of directors. For example, firms emphasizing organizational innovation should consider appointing more R&D executive directors. Similarly, executive directors with extended tenure are more likely to have a heightened understanding of their firms, thus enabling them to better assess innovation projects. In sum, these findings support our view that not all executive directors are equal – that a more nuanced view of executive directors is warranted.

Contributions

First and foremost, our study contributes to the literature on board composition (Davidson *et al.*, 2015; Hersel *et al.*, 2019). While this literature has largely treated executive directors as a homogeneous group who share similar interests and motivations, our findings suggest that both executive director involvement in R&D and organizational tenure lead them to exhibit different behavior toward innovation that may mitigate the potential negative impact their presence on the board (Wang *et al.*, 2019). By shifting our focus to consider behavioral characteristics, we suggest that firms can be tactical in composing their boards of directors to minimize the potential conflict of interest between executive and shareholders. From Figure 1, we see that not only did the presence of R&D knowledge help mitigate the negative impact of insiders, but that firms with large numbers of insiders had lowest levels of innovation when their boards did not contain an executive knowledgeable in R&D. This finding furthers our understanding of how the level of firm innovation is not merely a function of having executive directors but is also very much tied to the functional backgrounds of these executives. Given this link, future research could examine whether certain executive director backgrounds impact other organizational outcomes. For example, similar to the work of Fligstein (1990), firms interested in increasing their long-term efficiency may benefit from selecting executive directors with operations backgrounds. Seen in this way, the board becomes less a creature of governance and more of an active player in firm strategy, resulting in the need for more a purposeful selection of board members.

Second, this paper contributes to understanding the types of knowledge that influence a board's decisions regarding its firm's level of innovation. Our results show that high executive director tenure positively moderates the executive director-innovation relationship. As Figure 2 illustrates, firms with high tenured executive directors always experience more innovation than those with low tenured executive directors. This finding, in conjunction with Hypothesis 2, has important theoretical implications for the impact of board knowledge on firm actions. The knowledge granted from organizational tenure represents a general type of knowledge about the firm (Chen, 2013). This type of knowledge offset the negative effects of having high insiders. Comparing Figures 1 and 2 shows that while having an executive with knowledge specific to the outcome of interest (i.e., R&D) offset the negative impact of insiders, it was only when a board contained executives with general knowledge of the firm did, we see a complete reversal of the insider-innovation relationship. These findings suggest that executive directors with high levels of R&D knowledge are not enough to completely overcome the status quo. Rather, those executives with general knowledge of their firms can and do overcome the risk aversion inherent in insider boards. We suggest that future research should examine how firms that match their board composition, in terms of board member's knowledge, to what the firm is trying to accomplish can have different implications on firm innovation level and firm performance. For example, a manufacturing firm might benefit more from having an executive director with an operations background who can push for innovative solutions in managing and streamlining operations. Similarly, a medical devices firm may consider appointing an executive director who practiced medicine, or a customer service focused firm may benefit from having its chief marketing officer on the board of directors.

Although counter-intuitive, executive directors with long tenure are shown to have more impact on a firm's innovation compared to R&D executive directors. This suggests a power dynamic with very real consequences, yet little work examines these dynamics on boards. Future research should further investigate how executive directors manage their relationships as their tenure increases and the ramifications of these relationships on executive directors' power. With longer tenure, executive directors may build strong formal and informal relationships that allow them to influence innovation decision-making in different ways. Additionally, future research should examine how their organizations perceive executive directors with longer tenure. With longer tenure, executive directors may be viewed as more experienced or knowledgeable about firms' capabilities and rivalry. This perception may result in organizations assigning higher importance or weight to the opinions of those executive directors with longer tenure.

Finally, future research should also consider the impact of other behavioral characteristics that can cause executive directors-firm innovation negative relationship to vary. For example, executives' international experience and diverse functional background are known to be strong drivers of firm

innovation. Future research should examine if these two characteristics can have similar effects in the case of executive directors. Another relevant area that could be examined is related to executive directors' relationships with other executives and other directors, and how these relationships may cause executive directors to be beholden to one group over other.

Limitations

Despite the interesting results presented, there are some limitations of this study. First is the issue of generalizability. Given our interest in innovation, we believe our selection of R&D intensive industries was justified. However, we did focus only on three industries. We hope future research employs broader samples to better assess the applicability of our findings. Second, our measure for innovation was patent counts. While this is a widely used surrogate for innovation in the strategy literature, it is still a surrogate. Moreover, patents are a less relevant indicator of innovation in many industries (such as in services). We suggest that as researchers expand on our findings, alternate measures of innovation will be employed to better gauge innovation in relatively low-patent industries.

In this paper, we argue that the negative relationship between innovation and the presence of executive directors can be mitigated by these directors' R&D involvement and organizational tenure. The findings support our theory that greater knowledge of the firm and its capabilities will help insider boards overcome their risk averseness, allowing them to accept greater levels of innovation. But while R&D knowledge did help to mitigate the negative impact of executive directors on innovation, our results show that organizational tenure is the most beneficial to organizational innovation. These findings change our current understanding of insiders as a homogeneous group with similar behavior towards innovation and have practical implications on how firms form their boards of directors. We believe the current manuscript adds greater nuance to the board-innovation relationship and it is our hope that future scholarship will continue investigating the dynamics underlying this relationship.

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