

# Aligning the Stars: How Technology Committees and Relevant Resources Drive Firm Innovation

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*While many boards adopt technology committees to support firm innovation, the impact of such committees is largely unexplored. We draw on agency and resource dependence theories to suggest that technology committees can improve firm innovation (patenting and new product introductions). We further hypothesize that relevant committee expertise (technology and executive expertise) enhances the effectiveness of the committee, and that the benefit of committee expertise is strengthened when coupled with financial resource provision. Our results support our theorizing about the impact of technology committees—they positively impact new product introductions, although they had no impact on patenting. We also found that committee expertise*

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*enhances committee effectiveness, but only when accompanied by greater financial resources. We discuss the implications of optional board structures, such as technology committees and their composition, on firm innovation.*

**Keywords:** *technology committee; board of directors; corporate governance; innovation*

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## Introduction

Innovation is an increasingly strategic imperative for firms. However, investments in innovation are costly and risk laden, and the results typically are not known for years. Therefore, investments in innovation require significant short-term costs in exchange for uncertain long-term payoffs. As such, agency theorists have long argued that executives often avoid pursuing projects with this profile, potentially forgoing value creation (Finkelstein, Hambrick, & Cannella, 2009; Hoskisson, Chirico, Zyung, & Gambeta, 2017).

Further, agency theory also suggests that a critical role of the board of directors is to monitor executives to ensure they take actions that increase long-term shareholder value, such as investing in innovation projects and bringing that value to fruition for their firms (Kor, 2006; Schnatterly, Calvano, Berns, & Deng, 2021). Yet, the breadth and complexity of tasks that directors must collectively address raise significant time and resource challenges (Boivie, Bednar, Aguilera, & Andrus, 2016). As a result, directors often rely on board committees to focus on specific responsibilities (Kolev, Schepker, Wangrow, & Barker, 2023; Kolev, Wangrow, Barker, & Schepker, 2019). Key tasks are delegated to those committees as a means of shifting the effort to smaller, specialized board subgroups, effectively marshaling directors' resources for both monitoring and advice toward their committee-specific charges (Benaroch & Chernobai, 2017; Kolev et al., 2023). This specialization allows committee members to better understand the nuances of their committee domain, increasing their ability to monitor and advise more effectively than the board as a whole (Chen & Wu, 2016; Kolev et al., 2019).

Although some committees may be required (e.g., the audit, compensation, and nominating committees), others are optional, and thus their formation is contingent on idiosyncratic firm needs and board preferences. Many firms that have specific strategic needs form optional committees,<sup>1</sup> such as technology committees, which are specifically charged with monitoring and providing advice and counsel on activities designed to help firms successfully innovate (Benaroch & Chernobai, 2017). While some prior research has examined which firms tend to form technology committees (Premuroso & Bhattacharya, 2007) and their effectiveness in buffering negative abnormal stock returns (Higgs, Pinsker, Smith, & Young, 2016), we know very little about their actual effectiveness in fostering innovation outcomes. Building on prior arguments that committee members are better situated to monitor and advise more effectively than the collective board (Chen & Wu, 2016; Kolev et al., 2019), we theorize that the presence of a technology committee enhances firm innovation outcomes.

Further, resource dependence scholars have long argued that firms must secure essential resources to survive and thrive (Pfeffer & Salancik, 1978). Drawing on this thesis, governance scholars have argued that directors embodied with valuable expertise can enhance board functioning by providing relevant resources such as superior knowledge, insight, and

strategic advice (Hillman & Dalziel, 2003; Hillman, Withers, & Collins, 2009). In turn, those resources can enhance their firm's decision-making processes and, thus, the ability to address complex organizational challenges (Kor & Sundaramurthy, 2009). Extending this to the context of technology committees, we argue that because they are better positioned to see and act on the potential value of innovation opportunities, committees with greater relevant director expertise will help their firms achieve greater innovation outcomes than committees with lesser relevant expertise (Balsmeier, Buchwald, & Stiebale, 2014; Chen, 2014; Haislip, Lim, & Pinsker, 2021).

Finally, firm innovation outcomes are dependent upon the investment of financial resources (Howell, 2017; Muñoz-Bullón, Sanchez-Bueno, & De Massis, 2020). Without available financial resources for the necessary activities, there would be minimal innovation (Howell, 2017; Greve, 2003) and little for the committee members to encourage or monitor (Premuroso & Bhattacharya, 2007). Yet, financial investment targeted toward innovation without other critical supporting resources is unlikely to produce positive outcomes (Dalziel, Gentry, & Bowerman, 2011). Building on this, we theorize that greater financial resources enhance the positive relationship between a technology committee's member expertise and firm innovation outcomes.

To summarize, first we examine the impact of technology committees on firm innovation outcomes. Second, we focus on firms with technology committees only and examine the influence of committee technological expertise and C-suite experience on two important innovation outcomes: firm patents and new product introductions. Finally, we argue that greater financial resources available for innovation, in this context, firm research and development (R&D) expenditures, will positively moderate the impact of relevant committee member expertise on innovation outcomes.

Our research offers two key contributions to the governance and innovation literatures. First, we theorize and find that optional committees can successfully support firms' strategic priorities. Specifically, the presence of a technology committee enhances firm innovation by positively impacting new product introductions. This finding is significant, as product introductions represent the monetization of patents and are essential for the growth and development of firms (Nerkar & Roberts, 2004) and a bellwether of longer-term value creation (Sharma, Saboo, & Kumar, 2018). Further, our study advances traditional governance research by highlighting how optional board committees perform important governance functions, complementing the work of the full board, and thus enhancing board effectiveness in the areas under their specific purview.

Second, we contribute to our understanding of how to get the most out of optional board committees. We find that, while relevant committee expertise alone is not predictive of enhanced firm innovation, when coupled with greater financial resources in support of the committee's charge, the joint effect on new product introductions is substantial. This is an important finding as it provides initial evidence that committee effectiveness can be contingent on more than expertise alone and on more than financial resource provision alone. In isolation, neither is sufficient for enhancing committee outcomes. Further, the joint impact of financial resources and committee expertise provides unique insights into the practical necessity of adequately designing and supporting the committee in pursuing its charge. Thus, our research offers important evidence-based insights to governance and innovation scholarship and practice.

## Theory and Hypotheses

Directors are ideally positioned to influence firm outcomes (e.g., Hillman & Dalziel, 2003; Khanna, Jones, & Boivie, 2014; Schnatterly et al., 2021) because of their central position within firms (Garg & Furr, 2017; Lungeanu & Zajac, 2019). Agency theory (Jensen & Meckling, 1976) suggests that one core director task is to monitor management to ensure the pursuit of long-term value-enhancing outcomes on behalf of shareholders (Fama, 1980; Hillman & Dalziel, 2003). However, the breadth and complexity of tasks that directors address raise significant time and resource challenges which may limit directors' ability to effectively monitor (Boivie et al., 2016). As a result, directors often rely on board committees to focus on and bring attention to specific responsibilities (Kolev et al., 2019, 2023). This allows directors on a particular committee to monitor committee-specific issues more effectively, rather than across the breadth of issues with which the whole of the board is charged.

Further, board members with "relevant complementary knowledge" are necessary so that the "decision control system works well" (Fama & Jensen, 1983: 314). Directors' relevant complementary knowledge can go beyond the expertise required to monitor, as expertise also underlies directors' ability to offer recommendations and guidance for firms. Indeed, resource dependence theory (Pfeffer & Salancik, 1978) suggests that the resource provision role of directors includes applying their expertise to advise and counsel firm managers (Hillman & Dalziel, 2003). Thus, based on a firm's context and needs, directors with more relevant expertise stand to add greater value than directors with less relevant expertise (Hillman et al., 2009; Schnatterly et al., 2021). However, as we explain, relevant director experience is particularly vital in the board committee context.

### *Board Committees*

Agency theorists have long argued that the primary role of the board of directors is to monitor firm actions and behaviors (Fama, 1980; Hillman & Dalziel, 2003; Jensen & Meckling, 1976). In a more nuanced approach, scholars have recently argued that board committees can enhance board effectiveness by focusing a subset of directors' time and attention on a specific task (Kolev et al., 2019). In this way, committees have several advantages over the board as a whole for accomplishing particular critical tasks. Specifically, committees can "provide [an] efficient structure for utilizing directors' . . . time" (Arthaud-Day, Certo, Dalton, & Dalton, 2006: 1123), including task allocation and knowledge specialization (Chen & Wu, 2016). This knowledge specialization allows directors with relevant expertise to have a stronger impact on the success of the committee in accomplishing its charge (Carter, D'Souza, Simkins, & Simpson, 2010). Furthermore, committees are smaller than the full board and can operate both more efficiently and effectively (Chen & Wu, 2016; Klein, 2002; Kolev et al., 2019, 2023). Finally, committees also meet more frequently than the entire board, which can improve relevant discussions (Chen & Wu, 2016; Kolev et al., 2019). Consequently, relative to the full board, committees are ideally positioned to influence firm effectiveness by enabling more precise monitoring and specific advice and counsel targeted at achieving the specific committee charge.

In the United States, regulators require boards to have three committees: Audit, Compensation, and Nominating/Governance. However, many boards institute additional optional committees. Because firms have, on average, only one optional committee in addition to the three required

committees (Chen & Wu, 2016), forming an optional committee offers insights into firms' strategic priorities (Kolev et al., 2019). Some boards establish optional committees to ensure that critical specialized tasks are addressed (Kolev et al., 2023). As we explain below, one such optional committee that has grown in popularity is the technology committee.

### *The Technology Committee*

Firm directors and technology consultants have recently indicated an increased need for some firms to form a specific committee to provide focused monitoring of technology engagement and development efforts beyond merely relying on the full board or having it as a peripheral topic of committees focused on other priorities, such as the risk and audit committee (Forrest, Li, Tamburro, & Van Kuiken, 2022). Firms that have Technology Committees<sup>2</sup> use them to monitor ongoing innovative activities, drive R&D and product development objectives, protect intellectual property, and evaluate their technology position relative to competitors (Benaroch & Chernobai, 2017; Beulen & Bode, 2021; Forrest et al., 2022; Premuroso & Bhattacharya, 2007). In doing so, they are better able to mitigate technology-related risks and capitalize on technology-related opportunities (Harrast & Swaney, 2019; Price & Lankton, 2018).

Technology-focused firms are a clear fit for such a committee. For example, Cray Inc. charged their "Strategic Technology Assessment Committee" with providing "oversight of our technology development, including our product development roadmap and . . . the competitiveness of our offerings in the marketplace" (Cray Inc, 2015: 14). Hewlett Packard's "Technology Committee" is charged with providing "guidance on the impact of investment and other actions upon the strength of our intellectual property and technology strategies" (Hewlett Packard Proxy Statement, 2016: 13). However, any firm can consider forming a technology committee. For example, Chiquita Brands International charged their "Food Innovation, Safety & Technology Committee" with, "making well-informed choices in directing investment into areas related to food innovation" and "evaluating trends in research and development related to food innovation and safety" (Chiquita Brands International, Inc, 2011: 26). These committees have a clear charge to monitor and oversee the firm's innovation (see Appendix A for more examples of Technology Committee charges).

As stated above, innovation is costly, risky, and takes time to yield results. Consistent with agency theory predictions, managers tend to favor more certain short-term gains over riskier long-term gains, thus the delayed and uncertain payoffs of innovation can deter them from committing resources to such investments (Finkelstein et al., 2009; Hoskisson et al., 2017). Furthermore, managers hold significant information advantages over directors who meet infrequently, must attend to multiple board topics, and are less involved in day-to-day activities.

To curb this short-sightedness, directors are tasked with monitoring firm managers on behalf of firm owners (Fama, 1980; Jensen & Meckling, 1976). Committees can enhance this monitoring by focusing directors' attention on specific issues, resulting in reduced information asymmetry between management and committee members (Arthaud-Day et al., 2006; Kolev et al., 2019). Specifically, delegating certain tasks and responsibilities to committees helps directors focus their cognitive and social resources in support of the fulfillment of the committees' charge. In this case, having a technology committee allows its members to focus

on fulfilling the tasks of monitoring and advising the innovation process. The presence of committees also implicitly grants its members the authority to obtain information necessary to effectively perform their duties (Benaroch & Chernobai, 2017; Chatterjee, Richardson, & Zmud, 2001). Given that committees meet more often than the board, committee meetings allow directors to engage in more detailed discussion and evaluation of specific issues important to their charge, thereby potentially enhancing board decision-making by facilitating richer communication among members (Brick & Chidambaran, 2010). Thus, technology committees help board members gather and process more information about innovation processes in firms, reduce information asymmetry, and ultimately curb managerial short-termism, leading to increased innovation.

Thus, compared to the collective board, we argue that technology committees will more effectively monitor innovation related processes and provide the relevant resources necessary to enhance innovation outcomes. Therefore, we predict:

*Hypothesis (H1):* The presence of a technology committee is positively related to firm innovation.

### *Technology Committee Resources*

In their development of resource dependence theory, Pfeffer and Salancik (1978) argued that organizations must manage external dependencies and secure critical resources to achieve their objectives. These resources include providing expertise, advice, and counsel (Hillman & Dalziel, 2003). While the resource dependence literature has largely investigated the role of resource provision at the board level, as we argued earlier, these resources will be even more important at the committee level given that the delegation of tasks to committees enables the focusing of relevant resources on the specific committee charge (Benaroch & Chernobai, 2017; Kolev et al., 2023).

We further argue that the expertise of directors on a committee will be most influential when their expertise is related to the committee's charge. Such expertise or the "ability to comprehend the issues at hand" (Hambrick, Misangyi, & Park, 2015: 324) is acquired from directors' prior experiences and varies by director (Kor & Sundaramurthy, 2009). For directors, such expertise provides a lens through which they evaluate strategic issues and make decisions that ultimately influence firm outcomes (Jensen & Zajac, 2004; Kor & Sundaramurthy, 2009; Krause, Semadeni, & Withers, 2016; Schnatterly et al., 2021). This expertise is important for both opportunity exploration (Alvarez & Barney, 2007; Marvel, 2013) and exploitation (Bruns, Holland, Shepherd, & Wiklund, 2008; Dimov, 2010; Plambeck, 2012). That is, drawing on the specialized expertise and abilities of their members, board committees can execute tasks with greater efficiency and effectiveness (Chen & Wu, 2016; Kolev et al., 2019).

Regarding innovation, the types of expertise that are most likely to enhance the technology committee's impact on innovation are the directors' technological knowledge and their executive leadership (C-suite) experience. Technological expertise provides directors with a deep knowledge of the field and what is possible and what is not. Expertise in technology allows these directors to understand new technology and have insights into making new advances with existing technology (Chen, 2014). This expertise spans understanding the stages of development of research as well as its ultimate viability (Dalziel et al., 2011). Their

ability to comprehend technological trends and evaluate potential investments reduces uncertainty and enhances the likelihood of successful outcomes. In short, directors with technological expertise are likely to see advantages and opportunities for innovation that directors with little to no technological expertise might not (Feldman & Potamianos, 2005; Haislip et al., 2021; Higgs et al., 2016; Premuroso & Bhattacharya, 2007).

Further, directors who have experience at the very top of a firm have been involved in firm-level decision-making and have been exposed to varied external opportunities and environments, enabling them to bring this scope and experience to the committee (Haunschild & Beckman, 1998). These directors also possess information and knowledge about other firms and their strategies (Johnson, Schnatterly, Bolton, & Tuggle, 2011). This can enable them to better evaluate innovation opportunities and their commercial potential than those without such expertise (Chen, 2014; Balsmeier et al., 2014). Improved insights will also enhance the committee's ability to identify strategically important technology opportunities and trends (Chen, 2014) that align with overall firm strategy and, ultimately, facilitate strategic innovation (Li, 2019).

In sum, we argue that a technology committee with greater representation of directors with relevant expertise should have a greater ability to provide advice and counsel about a firm's innovative activity from the perspective of their deep or broad sources of information about innovation than firms with a technology committee with less expertise. Therefore, we predict:

*Hypothesis (H2):* For firms with a technology committee, greater relevant director expertise will be positively associated with firm innovation.

Finally, we argue that allocating financial resources to a committee with greater relevant member expertise will enhance its positive impact on innovation outcomes (Gerged, Kuzey, Uyar, & Karaman, 2023; Greve, 2003). The literature on leveraging employee expertise consistently finds that the resources provided to experts positively affect their ability to innovate and drive firm success (Call, Nyberg, & Thatcher, 2015; Huselid, 1995) at both the individual (Mollick, 2012) and team level (Kor, 2006). While financial resources, such as R&D expenditures, are often viewed as critical to innovation (Muñoz-Bullón et al., 2020), the allocation of financial resources alone does not directly lead to innovation (Dalziel et al., 2011). In our case, although we argue that expert directors can positively influence firm innovation, we further propose that this effect is stronger in firms that commit greater financial resources to R&D (Ancona & Caldwell, 1992; Mollick, 2012; Ruiz-Jiménez, Ruiz-Arroyo, & del Mar Fuentes-Fuentes, 2021; Tabesh, Vera, & Keller, 2019).

As stated above, we propose that expert directors are well positioned to understand and make sense of technological trends, opportunities, applications, and commercialization. Nonetheless, without sufficient financial resources invested, their innovation strategies might remain conceptual rather than actionable. That said, greater financial resources without expert oversight and advice might lead to agency problems as managers invest in more certain and short-term projects (Devers, McNamara, Wiseman, & Arrfelt, 2008). This work suggests that financial resources work in tandem with relevant director expertise to enhance innovative outcomes.

In sum, the improved monitoring and advising facilitated by technology committees comprised of members with greater relevant director expertise will have a stronger impact on innovation outcomes when sufficient financial resources are present. Therefore, we predict:

*Hypothesis (H3):* For firms with a technology committee, the positive relationship between relevant director expertise and firm innovation will be positively moderated by greater financial resources.

## Methods

We test our hypotheses using U.S. publicly traded firms from 2004 to 2021. Board data are from Morningstar and firm data are from Compustat. Firm innovation data (patents) are from the U.S. Patent and Trademark Office's (USPTO) Patentsview and new product introductions (NPI) from Ravenpack. Firms in industries that do not conduct, on average, at least nominal levels of R&D were excluded (industries where R&D intensity is below 0.01).<sup>3</sup> Excluding industries that do not conduct R&D, there remain 667 unique firms with a total of 7,169 firm-years between 2004 and 2018. The number of observations in the patent models is slightly lower due to missing patent data. We begin our study in 2004 due to the emergence of technology committees around this time. The dependent variables were collected from 2005 to 2019 for patents ( $t + 1$ ) and 2006 to 2021 for NPIs ( $t + 2$  and  $t + 3$ ). Note that the lengthy patent approval process means that patents applied for in 2019 are not all approved or denied for 3 or more years, making complete data for our sample available beginning in 2023. We also note that when analyzing the impact of director and financial resources on technology committees (H2 and H3) we included only firm-year observations with a technology committee. This sample consists of 144 firms with 906 firm-year observations. We also note that sample variables are winsorized at 1% and 99%.

### *Dependent Variables*

We employed two measures of innovation: patents and new product introductions (NPIs). Patents are an excellent measure of firm innovation (Cohen, 2010), as they are a foundational element of many forms of innovation (Artz, Norman, Hatfield, & Cardinal, 2010). We use the annual count of patents, measured as the number of successful patents applications (i.e., patents that were subsequently granted) filed during each fiscal year (Ahuja & Katila, 2001; Keil, Maula, Schildt, & Zahra, 2008).<sup>4</sup>

NPIs are another measure of innovation, one that captures the latter end of the innovation process (Artz et al., 2010; Griffin, 1993). NPIs reflect the successful use of patents leading to the commercialization of new knowledge. Where patents are a measure of the firm's ability to new knowledge, NPIs are a measure of the success of innovation that can directly impact firm value. Following Warren and Sorescu (2017), we calculated NPIs as the annual count of new product introductions announced each year.<sup>5</sup> Dependent variables are one year out for patents ( $t + 1$ ) and two and three years out for NPIs ( $t + 2$  and  $t + 3$ ) so that we can assess the impact in an appropriate timeframe for these phenomena. We utilize a longer lead time for NPIs than for patents because the time from idea to market is longer than from idea to patent (Griffin, 1993), and the 2- to 3-year lead time for NPIs has been used in previous scholarship (e.g., Nadkarni & Chen, 2014; Tyler & Caner, 2016).

### *Independent Variables*

We identified technology committees (*tech committee [TC]*) by first identifying committee titles using keywords that indicate the charge of a technology committee.<sup>6</sup> Second, three expert raters reviewed the committee titles and, when possible, committee charters to ensure we are capturing only committees that have a substantial innovation focus. Inter-rater reliability was 98%, with the discrepancies subsequently discussed and resolved. Committees that focused exclusively on IT security or other non-innovation topics were excluded from our study at that point. For example, we did not consider committees that focused solely on information security or cybersecurity to be technology committees in our study (see Appendix A in the online supplemental material for a full description of how we identify technology committees and examples of charters). We assigned 1 if the firm had a technology committee that year and 0 otherwise.

We operationalized director expertise as a count of the types of expertise represented on the committee (*Expertise Types on Tech Comm*: 0, 1, or 2) in order to capture the breadth of expertise assigned to the committee. Specifically, our independent variable would take the value of 0 if there were no directors with tech or C-suite expertise, 1 if there were at least one director with tech or C-suite expertise, and 2 if there were at least one director with tech expertise and at least one director with C-suite expertise (or one director with both types of expertise). We identified technology expertise (*Tech Experts on TC*) by searching director biographies for words that characterize technology expertise (Schnatterly et al., 2021). Technology expertise is a key type of expertise highly relevant to technology committees that is a critical component of individual (e.g., Boh, Evaristo, & Ouderkirk, 2014) and firm-level innovation (e.g., Wu & Shanley, 2009). Executive expertise is the second type of expertise we include. The number of C-suite directors on the technology committee (*C-suite on TC*) was determined by searching for keywords (e.g., “Chief Financial,” “Chief Marketing,” “Chief Operations”) in director job titles that indicated that the director was part of the C-suite at either their own firm or the focal firm.

To measure relevant financial resources for tech committees, we use *R&D Intensity*. It represents “the intensity of investment in the inputs supporting the innovation process” (Baysinger & Hoskisson, 1989: 319), which is precisely the type of resource provision that would be expected in support of the charge of a technology committee. Following prior research (e.g., Bromiley, Rau, & Zhang, 2017; Cohen & Levinthal, 1990), it is calculated as R&D expenditures divided by sales.

### *Control Variables*

We controlled for board and firm-level factors that can influence firm innovation. Board independence has been shown to positively impact firm innovation (Lu & Wang, 2018). We controlled for *CEO duality* (Adams, Almeida, & Ferreira, 2005) because it can influence the relationship between knowledge assets and firm innovation (He & Wang, 2009). *Board size* is the number of board members and has been found to be negatively associated with firm value (Defond, Hann, & Hu, 2005; Yermack, 1996). The number of annual *board meetings* is a measure of board activity and is related to higher firm value (Brick & Chidambaran, 2010). *Busy directors on BoD* is the count of directors that serve on three or more total boards (Ferris, Jagannathan, & Pritchard, 2003). We controlled for busy directors, as busier directors

have limited focus, which may detract them from their tasks (Boivie et al., 2016; Tuggle, Sirmon, Reutzler, & Bierman, 2010). *Average board tenure* is calculated using the total years spent on the board by all directors divided by the number of directors on the board. Similarly, *average board age* is calculated as the sum of all directors' age divided by the number of directors of the board. High *average board tenure* and *average board age* are negatively associated with strategic change (Golden & Zajac, 2001) which can influence the resource allocation and effectiveness of the committee. We used the log of total assets as a measure of *firm size* because firm size—and thus available resources—can impact innovation activities and output (Knott & Vieregger, 2020; Rogers, 2004). *Firm leverage* (Diestre, Rajagopalan, & Dutta, 2015) was calculated as total debt divided by total equity. Firm leverage was accounted for as it has been shown to impact not only R&D (Yang & Lai, 2021), but also innovation outputs (Iqbal, Xu, Fareed, Wan, & Ma, 2022). We included return on assets (*ROA*), as financial performance is often linked to innovation, both as a determinant (Audretsch, 1995; Bhattacharya & Bloch, 2004) and a consequence (Artz et al., 2010; Darroch, 2005). We also included board-level versions of director expertise variables (technology experts and C-suite) so that we could determine if any detected effects were attributable to board characteristics rather than to committee characteristics.

In our models that include only those firms with a technology committee (H2 and H3), we controlled for *committee size*, as it is an indication of number of directors on this committee (Defond et al., 2005).

### *Analytical Approach*

To investigate the impact of having a technology committee on firm innovation, we employed firm fixed effects Poisson regression with robust standard errors clustered by firm. Negative binomial is another distribution available for use with count models, but Poisson is more widely used (Park, Howard, & Gomulya, 2018) because it better controls for stable covariates and because negative binomial fails to adequately address over-dispersion (Allison & Waterman, 2002; Greene, 2007).

In testing the impact of resource allocation on firm innovation, we restricted the sample to firm years with a technology committee because our committee expertise variables are only applicable to firms with technology committees. Hausman tests indicated that the fixed-effects model (FE) specification is preferred, thus, we report these models as our main results in our tables. This choice also allows for the most conservative handling of any firm-level, time-invariant unobservables. However, we also ran random effects (RE) models because our predictions about resource allocation suggest between-firm effects, which is a stronger match conceptually to RE models (Certo, Withers, & Semadeni, 2017). Results remained robust to either specification choice.

## **Results**

Tables 1a and 1b provide descriptive statistics and correlations for all study variables. Sample firms had, on average, 54.65 annual patents and 3.58 new product introductions. Firms with a technology committee averaged 4.06 members on it, 1.07 of them being technology experts and 1.99 of them holding C-suite positions. The CEO was on the technology committee about 18% of the time.

**Table 1A**  
**Descriptive Statistics and Correlation Matrix for HI Sample**

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Total Patents	51.60	131.30														
2. New Product Introductions	3.80	5.66	0.53													
3. Tech Committees	0.12	0.32	0.00	0.00												
4. Board Size	9.32	2.34	0.29	0.30	0.09											
5. Board Meetings	8.21	3.63	0.02	0.08	0.04	0.01										
6. Busy Directors on BoD	2.26	1.99	0.32	0.30	0.07	0.54	0.01									
7. C-suite Directors on BoD	6.03	2.27	0.29	0.29	0.03	0.69	-0.04	0.57								
8. Tech Experts on BoD	1.87	1.66	0.08	0.19	0.10	-0.04	0.04	-0.03	0.08							
9. CEO Duality	0.45	0.50	0.04	-0.01	-0.02	0.05	-0.09	0.06	0.06	-0.13						
10. Firm Leverage	0.53	1.57	0.03	0.05	-0.01	0.15	0.05	0.14	0.14	-0.06	0.01					
11. Firm Size	7.40	1.89	0.50	0.50	0.02	0.66	0.04	0.56	0.57	-0.07	0.11	0.20				
12. Average Board Age	61.00	4.22	0.00	0.01	0.04	0.13	-0.03	0.08	0.06	-0.13	0.04	0.04	0.17			
13. Average Board Tenure	8.55	3.81	-0.03	-0.03	-0.08	-0.03	-0.14	-0.15	-0.11	-0.11	0.05	-0.06	0.02	0.52		
14. R&D Intensity	0.06	0.10	0.00	-0.01	0.24	-0.20	0.03	-0.07	-0.16	0.24	-0.09	-0.11	-0.37	-0.14	-0.10	
15. ROA	0.11	0.18	0.10	0.09	-0.14	0.14	-0.11	0.06	0.14	-0.07	0.04	0.04	0.32	0.10	0.12	-0.62

Note:  $n = 7,169$ . Correlation coefficients greater than  $|0.03|$  are significant at the 5% level. BoD = board of directors, CEO = chief executive officer, R&D = research and development, ROA = return on assets.

**Table 1B**  
**Descriptive Statistics and Correlation Matrix for H2-3 Sample**

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Total Patents	54.65	126.37																	
2. New Product Introductions	3.58	5.52	0.53																
3. Expertise Types on Tech Comm	1.54	0.69	0.01	0.00															
4. Tech Experts on Tech Comm	1.07	0.81	0.03	-0.03	0.77														
5. C-suite Directors on Tech Comm	1.99	1.34	0.09	0.05	0.59	0.37													
6. R&D Intensity	0.14	0.17	-0.16	-0.24	-0.04	0.04	-0.20												
7. Tech Committee Size	4.06	1.55	0.22	0.24	0.24	0.16	0.59	-0.23											
8. Board Size	9.89	2.43	0.30	0.52	-0.02	-0.06	0.19	-0.34	0.46										
9. Board Meetings	8.56	3.47	0.08	0.16	-0.03	-0.03	0.03	-0.02	0.08	0.14									
10. Busy Directors on BoD	2.77	2.15	0.22	0.30	0.11	0.10	0.17	-0.11	0.20	0.44	0.07								
11. C-suite Directors on BoD	6.33	2.18	0.26	0.27	0.29	0.18	0.53	-0.31	0.31	0.60	-0.02	0.44							
12. Tech Experts on BoD	2.32	1.61	0.10	0.04	0.39	0.65	0.16	0.04	0.00	0.01	0.02	0.04	0.17						
13. CEO Duality	0.40	0.49	0.11	0.16	0.02	-0.06	0.12	-0.19	0.09	0.19	-0.11	0.16	0.22	-0.10					
14. Firm Leverage	0.50	1.69	0.05	0.09	0.01	0.02	0.09	-0.13	0.05	0.14	0.05	0.11	0.10	-0.03	0.01				
15. Firm Size	7.46	2.34	0.45	0.63	0.01	-0.05	0.21	-0.54	0.39	0.76	0.11	0.49	0.55	-0.01	0.30	0.18			
16. Average Board Age	61.37	3.69	-0.05	0.03	0.05	-0.04	0.13	-0.11	0.26	0.13	0.00	-0.08	0.02	-0.05	0.02	0.00	0.14		
17. Average Board Tenure	7.61	3.39	-0.07	-0.02	0.05	-0.11	0.15	-0.05	0.21	0.10	-0.16	-0.10	0.06	-0.15	0.08	-0.02	0.11	0.54	
18. ROA	0.01	0.27	0.18	0.27	0.02	-0.02	0.18	-0.79	0.30	0.41	-0.02	0.12	0.32	0.02	0.20	0.11	0.61	0.16	0.15

*Note.*  $n=906$ . Correlation coefficients greater than  $|0.07|$  are significant at the 5% level. BoD = board of directors, ROA = return on assets, tech comm = technology committee.

**Table 2**  
**Firm Fixed Effects Regression Models for H1**

Variables	Model 1	Model 2	Model 3
	Patents (t + 1)	New Product Introductions (t + 2)	New Product Introductions (t + 3)
Tech Committees	0.02 (0.309)	0.14 (0.031)	0.16 (0.028)
Total Patents	0.00 (0.000)	-0.00 (0.258)	-0.00 (0.414)
New Product Introduction	0.00 (0.837)	0.01 (0.000)	-0.01 (0.080)
Board Size	-0.00 (0.959)	-0.00 (0.906)	0.02 (0.227)
Board Meetings	-0.00 (0.142)	-0.00 (0.871)	0.00 (0.989)
Busy Directors on BoD	-0.00 (0.838)	0.01 (0.578)	0.00 (0.971)
C-suite Directors on BoD	-0.00 (0.743)	0.01 (0.440)	0.01 (0.540)
Tech Experts on BoD	0.02 (0.054)	0.00 (0.797)	-0.01 (0.543)
CEO Duality	0.04 (0.055)	0.03 (0.514)	-0.02 (0.701)
Firm Leverage	-0.01 (0.008)	0.01 (0.092)	-0.00 (0.952)
Firm Size	0.14 (0.004)	0.13 (0.005)	0.10 (0.036)
Average Board Age	-0.01 (0.177)	-0.00 (0.864)	-0.00 (0.846)
Average Board Tenure	0.01 (0.188)	0.00 (0.798)	0.01 (0.487)
R&D Intensity	0.61 (0.043)	0.06 (0.914)	t0.18 (0.721)
ROA	0.54 (0.002)	0.27 (0.280)	0.26 (0.178)
Firm Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Observations/groups	6,646/576	7,169/667	6,586/657

*Note.* One-tailed  $p$ -values for hypothesized relationships and two-tailed  $p$ -values for all others are in parentheses. Robust standard errors clustered by firm. BoD = board of directors, ROA = return on assets, R&D = research and development.

In Hypothesis 1, we predicted that having a technology committee would positively impact firm innovation. Table 2 shows our Poisson fixed effects models for the impact of technology committees on  $\text{Patent}_{t+1}$ ,  $\text{NPI}_{t+2}$ , and  $\text{NPI}_{t+3}$ . In support of H1, firms with a technology committee had more new product introductions 2 years ( $\beta=0.14, p=.031$ ) and 3

years ( $\beta=0.16, p=.028$ ) later. There was no impact on patents 1 year later ( $\beta=0.02, p=.309$ ). Thus, we find that technology committees are instrumental in enhancing some types of firm innovation outcomes, but not all.

To test Hypotheses 2 and 3, our models (see Table 3) include only firm-year observations with a technology committee. For H2, we did not find support for our prediction that relevant expertise (technology and C-suite) on a technology committee would improve firm innovation for Patents<sub>t+1</sub> (Model 1;  $\beta=-0.04, p=.109$ ), NPI<sub>t+2</sub> (Model 3;  $\beta=-0.01, p=.428$ ), or NPI<sub>t+3</sub> (Model 5;  $\beta=0.10, p=.115$ ). It seems that providing expert directors to a technology committee does not alone improve the efficacy of the committee in driving innovation outcomes.

In H3 we suggested that the benefit of expert directors on a technology committee would be enhanced by supporting them with higher levels of financial resources so that they will be more fully able to bring their expertise to bear on matters of firm innovation. We found strong support for H3, but only for new product introductions. Our results indicate that director expertise and R&D intensity do not jointly improve Patents<sub>t+1</sub> (Model 2;  $\beta=0.15, p=.266$ ) but do jointly improve NPI<sub>t+2</sub> (Model 4;  $\beta=1.82, p<.001$ ) and NPI<sub>t+3</sub> (Model 6;  $\beta=0.87, p=.038$ ). To aid in the interpretation of these two-way interactions, we plot the marginal effects of R&D intensity across the values of expertise types as suggested by Busenbark, Yoon, Gamache, and Withers (2022). While Figure 1 indicates that there is no significant relationship across relevant directors' expertise types, Figures 2 and 3 indicate that relevant director and financial resources must both be provided at high levels in order to increase new product introductions. These results suggest there is some nuance to effectively provisioning a technology committee. It might not be sufficient to provide only director expertise to a technology committee, even if done at a high level, under conditions of lower financial resources.

### *Robustness of Results and Endogeneity*

To ensure our results are robust to our time horizon choices, we tested models for patents at 2 and 3 years out and NPI models 1 year out. We found our H1 results to be largely robust to these modifications. The only difference was a slightly lower significance of the impact of technology committees on NPI<sub>t+1</sub> ( $\beta=0.70, p=.061$ ). H2 and H3 results were unchanged using various lead times.

To assess the robustness of our director expertise measure we retested H2 and H3 with an aggregate count of the total number of technology experts plus the total number of C-suite directors (mean=3.07, range 0 to 6) on the technology committee. All H2 and H3 results were consistent in all material respects with this operationalization.

We also investigated multi-collinearity issues due to the inclusion of many board and committee-level variables which can cause inflated standard errors, potentially diminishing the significance of results. Notably, firm size, board size, average board age, and ROA had variance inflation factors above 10 in some models, but, when omitted, results remained consistent.

Endogeneity is a critical concern when seeking to understand strategic phenomena, such as the impact of choices that are made by some firms but not others (e.g., the choice to form a technology committee). Thus, for H1, we sought to carefully address the issue of biased results in a number of ways, such as firm fixed effects to manage bias from time-invariant

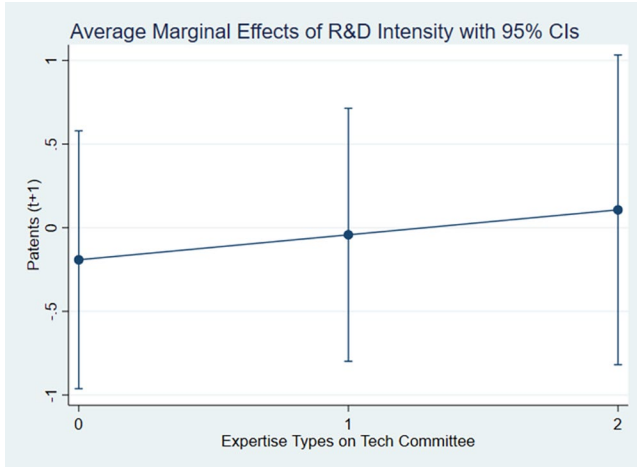
**Table 3**  
**Firm Fixed Effects Regression Models for H2-3**

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Patents (t + 1)		New Product Introductions (t + 2)		New Product Introductions (t + 3)	
Expertise Types on Tech Committee	-0.04 (0.109)	-0.06 (0.143)	-0.01 (0.428)	-0.18 (0.048)	0.10 (0.115)	0.02 (0.854)
R&D Intensity		-0.19 (0.683)		-1.57 (0.042)		-0.36 (0.673)
Expertise Types X R&D Intensity		0.15 (0.266)		1.82 (0.000)		0.87 (0.038)
Total Patents	0.00 (0.000)	0.00 (0.000)	0.00 (0.019)	0.00 (0.006)	0.00 (0.608)	0.00 (0.542)
New Product Introduction	-0.01 (0.210)	-0.01 (0.218)	-0.02 (0.010)	-0.02 (0.007)	-0.02 (0.004)	-0.02 (0.004)
Tech Committee Size	0.06 (0.014)	0.06 (0.014)	-0.01 (0.791)	-0.01 (0.861)	-0.03 (0.387)	-0.03 (0.406)
Board Size	-0.04 (0.001)	-0.04 (0.000)	0.02 (0.386)	0.02 (0.416)	0.00 (0.947)	0.00 (0.921)
Board Meetings	0.01 (0.446)	0.01 (0.429)	0.01 (0.427)	0.01 (0.417)	0.00 (0.846)	0.00 (0.831)
Busy Directors on BoD	0.02 (0.132)	0.02 (0.131)	0.01 (0.698)	0.02 (0.619)	0.00 (0.955)	0.00 (0.916)
C-suite Directors on BoD	0.06 (0.025)	0.06 (0.025)	-0.01 (0.783)	-0.02 (0.647)	0.01 (0.667)	0.01 (0.782)
Tech Experts on BoD	0.02 (0.445)	0.02 (0.421)	-0.03 (0.240)	-0.03 (0.277)	-0.01 (0.720)	-0.01 (0.763)
CEO Duality	0.06 (0.380)	0.06 (0.386)	-0.08 (0.455)	-0.09 (0.358)	-0.01 (0.915)	-0.02 (0.879)
Firm Leverage	-0.01 (0.683)	-0.01 (0.709)	0.01 (0.524)	0.01 (0.481)	0.02 (0.396)	0.02 (0.407)
Firm Size	0.15 (0.099)	0.15 (0.121)	0.26 (0.047)	0.28 (0.023)	0.28 (0.119)	0.30 (0.078)
Average Board Age	-0.02 (0.427)	-0.02 (0.434)	0.03 (0.270)	0.04 (0.176)	0.03 (0.506)	0.03 (0.460)
Average Board Tenure	0.04 (0.034)	0.04 (0.033)	0.03 (0.370)	0.03 (0.420)	0.03 (0.525)	0.03 (0.545)
ROA	-0.01 (0.991)	0.00 (0.994)	0.19 (0.742)	0.55 (0.377)	-0.03 (0.949)	0.22 (0.715)
Firm Fixed Effects	Yes		Yes		Yes	
Year Fixed Effects	Yes		Yes		Yes	
Observations/groups	906/144		782/116		692/107	

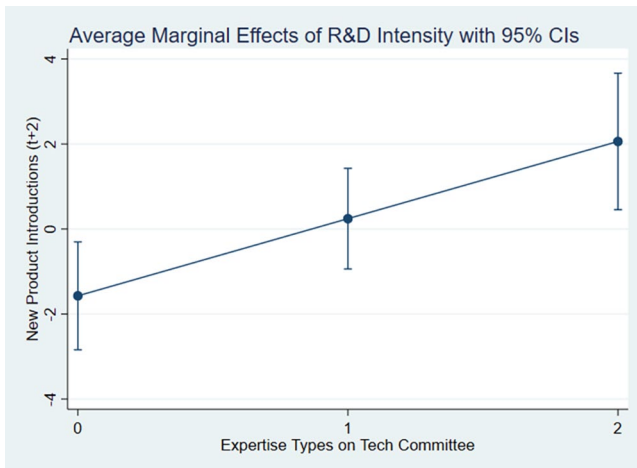
*Note.* One-tailed  $p$ -values for hypothesized relationships and two-tailed  $p$ -values for all others are in parentheses. Robust standard errors clustered by firm. BoD = board of directors, CEO = chief executive officer, ROA = return on assets, R&D = research and development.

omitted variables and including  $t=0$  versions of the dependent variables as predictors of the  $t + 1$  (patent) and  $t + 2/t + 3$  (NPI) dependent variables (Blundell, Griffith, & Reenen, 1995), which helps rule out a reverse causality explanation.<sup>7</sup> We addressed selection bias by

**Figure 1**  
**Marginal Effects of R&D Intensity on Patents (t + 1) Across the Values of Expertise on Tech Committee**

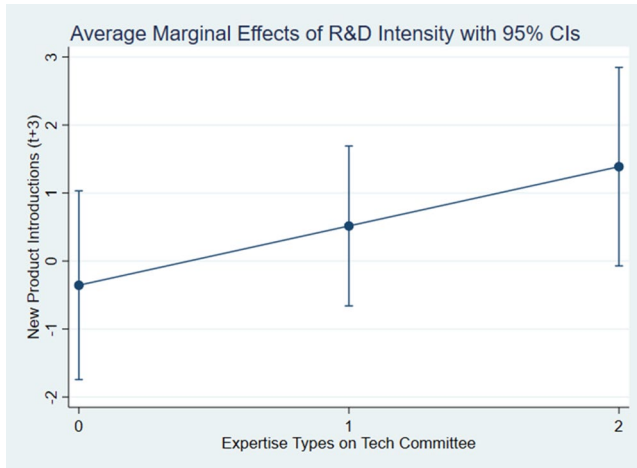


**Figure 2**  
**Marginal Effects of R&D Intensity on NPI (t + 2) Across the Values of Expertise on Tech Committee**



supplementing our main results with endogenous switching regression (ESR) estimation (Barbopoulos, Adra, & Saunders, 2020; Hamilton & Nickerson, 2003; Iyengar & Zampelli, 2009). ESR is a generalized version of Heckman’s (1979) two-stage correction method. We chose ESR instead of 2SLS because it corrects for the same types of bias as 2SLS, but also allows us to model the difference between the endogenous impact of two mutually exclusive

**Figure 3**  
**Marginal Effects of R&D Intensity on NPI ( $t + 3$ ) Across the Values of Expertise on Tech Committee**



strategic paths—choosing to have a technology committee or choosing not to. ESR is particularly appropriate to answering “what-if” questions (Golubov, Petmezas, & Travlos, 2012) because it assesses the impact of technology committees overall by estimating both the factual and counterfactual of having a technology committee: the impact to those that chose to have one and the “what-if” impact had the firms without one chosen to have one. In the two-step procedure, the first-stage selection equation predicts the probability of having a technology committee and calculates the inverse mills ratio for each category of firms (those with and without a technology committee). In the second stage, we regress innovation performance on the inverse mills ratio (and controls) separately for each strategic path. This method is frequently employed in the strategy literature (e.g., Hasan, Kobeissi, & Wang, 2011; Park & Ro, 2013; Weigelt, 2013).

We utilized the percentage of industry firms with a technology committee squared (*industry TC squared*) as an instrumental variable in Stage 1, as it meets the exclusion criteria that it not be correlated with the dependent variable residuals (Heckman, 1990). It also fulfills the relevance condition, as the prevalence of technology committees in the industry does predict the adoption of a technology committee by a focal firm. Because the relationship between prevalence and adoption is an inverted “U” shape (Rogers, 2003), we use a squared term.

In support of the relevance condition, *industry TC squared* is highly significant as a predictor of the likelihood of having a technology committee for Patent<sub>t+1</sub> NPI<sub>t+2</sub>, and NPI<sub>t+3</sub> (Model 1,  $\beta = -23.03$ ,  $p < .001$ ; Model 4,  $\beta = -24.68$ ,  $p < .001$ ; and Model 7,  $\beta = -22.11$ ,  $p = .001$ , respectively, as shown in Table 1B in Appendix B). This indicates a successful selection step—that firms indeed self-select into having a technology committee or not, to a degree that could bias second-stage coefficients if not corrected.

Models 2–3, 5–6, and 8–9 of Table 1B in Appendix B display the second-stage results. The inverse mills ratios,  $\lambda$ , are added from the first stage to correct for self-selection. Switching regression estimation separates the key independent variable into regimes (TC and

non-TC firms) in order to isolate the comparative impact. Thus, to draw inference on the impact to firm innovation, we compare the overall effects contained in the body of information within the regime models (Model 2 vs. 3, 5 vs. 6, and 8 vs. 9). To this end we calculated the average treatment effects of having, or not, a technology committee (see Table 2B in Appendix B). Results are parallel to our FE Poisson results: models with NPI as the DV support H1 while the patent DV model does not. For instance, firms with a technology committee are predicted to have 5.85 new product introductions 2 years later compared to 3.91 for firms without, after correcting for selection bias. Interestingly, firms with a technology committee are predicted to have 3.38 fewer patents 1 year later compared to firms without a technology committee. In all cases, mean differences are highly significant ( $p < .001$ ). Thus, in partial support of Hypothesis 1, having a technology committee improves the rate of some (NPI) but not all types (not patents) of firm innovation.

In addition to using ESR, we also addressed the potential for influential omitted variables in our study by analyzing the robustness of inference to replacement for each hypothesized relationship using the KonFound-it! spreadsheet (Frank, 2000; Frank, Maroulis, Duong, & Kelcey, 2013; Xu, Frank, Maroulis, & Rosenberg, 2019). The results reported in Table 3B in Appendix B indicate that to invalidate the results regarding the technology committee influence on  $NPI_{t+2}$  in Models 2 in Table 2, 882 observations (or 12% of our sample) would have to be replaced with cases with a zero effect. Further, results indicate that to invalidate the results regarding the technology committee influence on  $NPI_{t+3}$  in Model 2 in Table 3, 921 observations (or 14% of our sample) would have to be replaced with cases with a zero effect. This suggests that the potential for omitted variable bias is limited in our sample.

Finally, to further address endogeneity concerns related to simultaneity/causality (see Hill, Johnson, Greco, O'Boyle, & Walter, 2021, for a review of the causes of endogeneity) we employed the difference-in-differences (DID) methodology (Meyer, 1995; Villa, 2016), which is a popular choice to determine differences between treatment and control groups across time, thereby ascertaining the causality of the relationship of interest. First, we employed coarsened exact matching (CEM; Blackwell, Iacus, King, & Porro, 2009; Iacus, King, & Porro, 2011), which coarsens data across covariates to match treatment with control observations. CEM is increasingly being used to determine matched samples in management research (e.g., Kang & Suarez, 2023; Khanna & Guler, 2022). Further, pairing CEM and DID techniques is increasingly used (e.g., Aydin Ozden & Khashabi, 2023; Jain & Huang, 2022; Mitsuhashi & Nakamura, 2022) because it produces more precise matches than alternative techniques (Iacus et al., 2011). Covariates used for matching included board size, firm size, firm leverage, and ROA. Matching on these characteristics was done in the year before technology committee adoption (pre-TC) by the treatment group members.

Once matched, DID was conducted to ascertain whether a technology committee significantly impacted our outcomes of interest. Specifically, we compared NPIs and patents of firms pre-TC and post-TC with comparable firms obtained through CEM matching in corresponding years. Our analyses incorporate CEM derived weights to account for the differing size between treatment and control groups (Blackwell et al., 2009; Iacus, King, & Porro, 2012).

Results of our CEM-matched DID analyses are presented in Table 4B in Appendix B. While accounting for the same controls as in the primary analyses, clustering by firm, and using robust standard errors, the DID analysis indicates that significant difference-in-differences in pre- and post-means exist for NPIs ( $DID=0.816$ ,  $SE=0.400$ ,  $p=.042$ ), but not patents ( $DID=-0.743$ ,  $SE=7.218$ ,  $p=.918$ ). Thus, our primary results are again corroborated.

### *Post Hoc Supplemental Analysis*

While we theorized about director resources as an aggregate concept, we were, nevertheless, interested in whether technology expertise or C-suite expertise on a technology committee might independently influence innovation (H2) or whether they might differ in how they interact with R&D intensity. Thus, we also investigated models with technology and C-suite expertise as separate variables. These results are displayed in Table 5B in Appendix B. In support of H2, C-suite directors on a technology committee increased Patents<sub>t+1</sub> (Model 1,  $\beta=0.06, p=.021$ ). Yet, contrary to H2, technology experts on a technology committee had a marginal negative effect on Patents<sub>t+1</sub> (Model 1,  $\beta=-0.05, p=.094$ ) and a negative effect on NPI<sub>t+2</sub> (Model 4,  $\beta=-0.14, p=.035$ ). Consistent with our main results for H3, we see evidence for a two-way interaction where expertise and R&D intensity jointly impact new product introductions, but not patents. For NPI<sub>t+2</sub>, technology expertise (Model 5,  $\beta=1.15, p=.005$ ) and C-suite experience (Model 6,  $\beta=1.30, p<.001$ ) each positively interact with R&D intensity. For NPI<sub>t+3</sub>, C-suite expertise and R&D intensity positively interact (Model 9  $\beta=0.64, p=.009$ ). To enhance interpretation, we again plot the marginal effects of R&D intensity across different values of technology and C-suite expertise (Figures 1B–6B in Appendix B). In these figures, we see the same general relationships suggested in our main models and displayed in Figures 1–3. High levels of expertise and high levels of R&D intensity are both necessary conditions for these resources to positively impact firm commercialization of innovation.

## **Discussion and Conclusion**

Our study seeks to ascertain the impact of optional board structures on firm innovation. Specifically, we explore the role of the technology committee on firm innovation outcomes (patenting and new product introductions) as an important case of the relationship between optional committee-level board structures and firm-level outcomes. Previously, scholars have suggested that boards might have a significant impact on innovation (Dalziel et al., 2011; Sarto, Saggese, Viganò, & Mauro, 2019; Zahra, Filatotchev, & Wright, 2009). Yet, prior studies implicitly assume that all directors on the board focus on innovation issues with equal ability to contribute.

We found that having a technology committee indeed leads to greater firm innovation. Our arguments, based on agency theory, suggest that executives tend to focus more on short-term than long-term issues, and that committees can emphasize longer-term benefits. Our findings are notable as prior work has highlighted the purpose of technology committees (Benaroch & Chernobai, 2017), but without investigating their composition or their impact on innovation. Importantly, we found that having a technology committee is not a universal solution to categorically improving all types of firm innovation. Our results showed that technology committees did not improve subsequent year patenting activity but did lead to an increase in new product introductions both 2 and 3 years later. While we did not initially hypothesize this, it is reasonable that technology committees, with a charge focused on monitoring and driving firm value, focus on NPIs rather than patents. Patents in and of themselves tend to become more valuable when they are an input into commercialization. That is, commercialization of an innovation might have greater potential to increase firm value than patents that have not been developed into new products. As the board of directors represents the

shareholders, this is a dimension of innovation that is specific to their role. Thus, it is perhaps not surprising that the technology committee is more influential in advising and monitoring for those things the shareholders are most interested in.

More generally, we contribute in two significant ways to the emerging research on board committees and, specifically, optional committees. First, through our focus on the technology committee, our results demonstrate that optional board committees with a specific strategic focus can drive important firm outcomes. As such, our study extends current corporate governance research by demonstrating that the board and its required committees might not always be sufficient or optimal for performing all important governance activities. Our findings provide initial evidence that the delegation of responsibility to optional specialized board structures, such as the technology committee, can enhance board effectiveness. In our case, technology committees positively impact firm innovation via new product introductions.

Second, we contribute by showing that the endowment of expertise and financial resources in support of a committee function only in conjunction with one another. We found that appointing experts to a technology committee is, alone, not likely to enhance committee effectiveness. However, when combined with adequate financial resources in support of innovation, committee effectiveness was improved. We suggest future research examine the mechanisms that underlie this finding. Our study sheds new light on the influence of optional committees on firm outcomes, while recognizing that the strength of their effectiveness might be contingent on appropriate bundles of resources or support mechanisms. Thus, it has significant implications for both scholars and practitioners striving to broadly understand how committees affect the board's ability to effectively monitor and advise the firm.

Our supplemental analysis further unpacked the nuances of how technology committees influence firm innovation. We investigated the separate effects of technology expertise and C-suite experience to assess if one or the other type of experience might be driving our results (see Table 5B in Appendix B). First, the type of expertise on a technology committee seems to matter. We found that C-suite experience drove patenting activity while technology expertise on the committee had a slightly negative impact on new product introductions. Yet, despite a negative main effect of technology expertise on new product introductions, an increase in R&D intensity was positively related to NPIs when there is a high number of technology experts in the committee (Figure 2B in Appendix B). It seems that investing financial resources to foster innovation is beneficial when having more technology expertise on the committee, but when these resources are not present, technology experts on the technology committee are actually counterproductive.

This finding aligns with previous work suggesting that prior knowledge can, at times, be a limiting factor for effective decision-making and innovation (e.g., Almandoz & Tilcsik, 2016). Specifically, more directors from relevant domains (e.g., for this study, those with technology expertise) are negatively associated with innovation. That is, relevant prior knowledge can constrain the set of opportunities the individual perceives (i.e., knowledge corridors limiting opportunity recognition) indicating it can be negatively related to innovativeness (Marvel, Wolfe, & Kuratko, 2020). This shows that relevant expertise is a necessary, but not sufficient, condition for innovation, and if it is not paired with resources, it can be detrimental.

C-suite experience on technology committees was similarly important. Alone, C-suite experience had no impact on new product introductions, but when higher levels of C-suite

expertise are present on the technology committee, the allocation of financial resources towards innovation drive future product introductions (Figures 5B and 6B in Appendix B). In sum, our study offers evidence for the importance of technology committees, but with the caveat that they are most effective when endowed with the right combination of director experiential resources that also have the opportunity to leverage relevant financial resources. This is important as our study helps explain a more nuanced relationship between boards, optional committees, resources allocation, and innovation outcomes.

### *Practical Implications*

Our study highlights the importance of optional committees (and their composition) on firm innovation. As such, our study offers practical guidance for those seeking to improve firm innovation. Executives, for instance, might choose to form a technology committee with the charge to oversee the firm's efforts to commercialize innovations. Furthermore, executives should evaluate both the composition of the committee and the resources allocated toward the committee's charge. Similarly, investors might pressure executives to adopt these committees within their boards and see that their composition and resource allocations are appropriate. More broadly, this study suggests that desired strategic outcomes may be more effectively achieved by structuring the board in ways that are intentionally designed to support specific types of firm outcomes. That is, the board's structure and use of optional committees should reflect the strategic goals of the firm.

### *Limitations and Future Research*

While we sought to ascertain when and how boards can influence firm innovation, there are limitations to note. First, we utilized a sample of public U.S. firms. Thus, our results might not generalize to all contexts. For example, small private firms with fewer resources might not be able to adequately support a technology committee with sufficient expertise or financial investment. In such contexts, there are likely other combinations of structural choices that can align executives with long-term owner interests. Firm innovation is also a multifaceted construct that could be investigated more thoroughly. Bertrand and Mol (2013), for instance, distinguish between process and product innovation and find that they have distinct antecedents. Future work should seek more nuance in which outcomes governance structures influence, and why.

We also note that we have investigated only a single type of optional committee (the technology committee) in relation to a single area of impact (firm innovation). There are other ways in which a technology committee might impact firm outcomes, such as security risks (Higgs et al., 2016). Further, there are other optional committees that are formed with distinct charges. Examples include committees focused on ethics, safety, risk, and growth, to name a few. We hope that future work will build upon our work, which speaks to the strategic benefits of optional committees generally, and the need to support and provision such committees in specific ways that fit their charge.

Finally, as is common in much corporate governance work, our study draws on prior research and anecdotal evidence to make some assumptions about how technology committees operate. Specifically, we assume that technology committee members evaluate, discuss,

and make decisions regarding firm innovation issues. However, it is possible that different approaches and behaviors exist across different firms. As such, to address this limitation, we believe scholars could build on our findings with qualitative or policy-capturing studies that might offer more nuanced understanding of how technology committees seek and process information and make decisions regarding innovation in this important context.

## Conclusion

Our findings contribute to the innovation and corporate governance literatures by demonstrating the impact that a specific optional board structure—the technology committee—has on firm innovation. While most work on board structures focuses on required committees, this study advances the notion that optional committees are not only useful in addressing specific issues, but that they can positively influence firm outcomes particularly when endowed with sufficient relevant resources. This influence is also most specifically related to the goals of the stakeholders the board represents—the shareholders—through the impact of new product innovations rather than patents.

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## Notes

1. Boards of U.S. public firms are required to have an Audit, Compensation, and Nominating/Governance Committee. Any other committee is optional.
2. Boards have used a range of labels for a “technology committee.” We explain how we identified these committees in the Methods Section. Alternative names include: Science and Technology, Research and Development, Technology and Information, Innovation and Technology, and Product Innovation, among others.
3. Retail trade, wholesale trade, and public utilities.
4. We forgo a citation-weighted measure to preserve interpretability, as using a simple patent count is a well-validated measure, is highly correlated with weighted counts (Rothaermel & Hess, 2007), and captures the same underlying construct (Hagedoorn & Cloudt, 2003).
5. This is done in Ravenpack by including only items categorized as a “product release” and with a relevance score of 100 in order to ensure the NPI pertains to the focal firm.
6. Keywords: Innovation, research, development, science, computer, system, information, technology, electronic, digital, data, security, IT.
7. We also ran panel logit models with firm performance measures (patents, NPIs, and ROA) as predictors of technology committee formation and found them to not be predictive.

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