9-21-2022

Busy Boards, Entrenched Directors and Corporate Innovation

Brian Bolton
Portland State University, bbolton@pdx.edu

Jing Zhao
Portland State University

Citation Details

Bolton, B., & Zhao, J. (2022). Busy Boards, Entrenched Directors and Corporate Innovation. International Journal of Financial Studies, 10(4), 83.

International Journal of
Financial Studies

MDPI

Article

Busy Boards, Entrenched Directors and Corporate Innovation

Brian Bolton [1,*] and Jing Zhao [2]

[1] B.I. Moody III College of Business Administration, University of Louisiana at Lafayette, Lafayette, LA 70504, USA
[2] School of Business, Portland State University, Portland, OR 97201, USA
* Correspondence: brian.bolton@louisiana.edu

Abstract: We provide a comprehensive study of how different corporate governance mechanisms influence corporate innovation. Using panel data regression analysis across a sample of more than 13,600 firm-years for firms based in the United States between 1996–2010, we find that entrenched boards, though commonly associated with lower firm value, actually generate substantial innovation. We find that busy boards hinder innovation unless they also have interlocking relationships. Conversely, interlocked directors enhance innovation, unless they are busy. Directors who are CEOs or Board Chairs at other companies hinder innovation. Interestingly, despite being significant determinants of firm value in other studies, director experience, independence and ownership are not related to innovation. In order to be innovative, firms should appoint directors to leverage their professional relationships and directors must have a long-term perspective.

Keywords: corporate governance; corporate innovation; boards of directors; busy boards; entrenched directors; agency theory; incentive alignment; financing policy; ownership structure

Citation: Bolton, Brian, and Jing Zhao. 2022. Busy Boards, Entrenched Directors and Corporate Innovation. *International Journal of Financial Studies* 10: 83. https://doi.org/10.3390/ijfs10040083

Academic Editor: Sabri Boubaker

Received: 19 August 2022
Accepted: 7 September 2022
Published: 21 September 2022

1. Introduction

Innovation can be a critical part of a firm's strategy to create a competitive advantage over the competition and generate abnormal returns for shareholders. Yet innovation—through research and development, new products or patent development—is a long-term, expensive and risky investment. Firms must be willing to take long-term risks in order to innovate. In this paper, we study which corporate governance characteristics are most aligned with creating long-term value through corporate innovation.

Prior literature has studied the relationship between various corporate governance mechanisms and firm characteristics, including innovation, but this is the first paper to study the unique influence of director busyness and entrenchment on corporate innovation. Importantly, we show that board busyness is bad for innovation, despite any network effects that may be gained through multiple director positions, while director entrenchment is good for innovation. The entrenchment relationship is important because so many prior studies have found that entrenched directors are associated with worse firm performance, highlighting the need for scholars to disentangle the different channels through which entrenchment can impact firm strategies and goals.

One of the most important papers to show that director entrenchment is associated with worse firm performance is Bebchuk et al. (2009). In their seminal paper, Bebchuk et al. (2009) consider which corporate governance mechanisms matter the most for overall company performance. They identified six constructs—each of which seems far-removed from strategic and operational decision-making—that lead to superior firm performance. Yet, while these constructs may seem removed from strategy and operational activities, they establish the firm's culture of incentives that determines which strategic and operational decisions are made. Thus, superior firm performance should be the result of strategic decisions and long-term investments that create a competitive advantage. Investing in

innovation has been shown to be one such strategic decision that creates a competitive advantage and creates value (see Kogan et al. 2017; Hall et al. 2005).

From Hart (1995), a firm's corporate governance structure can be thought of as a system of risk-sharing and incentives; this means that a firm's corporate governance structure must properly incentivize managers and directors to take the long-term risks necessary for the firm to generate innovation. An impressive literature has recently emerged to study the relationship between corporate governance and innovation and to determine how corporate governance creates value through innovation. Chemmanur and Tian (2018) show that firms with more anti-takeover provisions innovate more. Sapra et al. (2014) find a U-shaped relationship: innovation occurs when there are very few or very many anti-takeover provisions. They attribute this to the long-term nature of innovation; firms—through executives and directors—need the long-term incentives and protection necessary to invest in innovation. Manso (2011) suggests that managers can be motivated to innovate by incentivizing them with long-term options, golden parachutes and other devices that encourage entrenchment. These studies are novel in many ways, most relevantly because the corporate governance mechanisms that they find lead to innovation—golden parachutes and entrenchment—are the exact opposite of what the literature generally believes are associated with effective corporate governance structures: entrenched directors are generally found to destroy firm value (see Gompers et al. (2003) and Bebchuk et al. (2009) on antitakeover provisions and Bhagat and Bolton (2013) on director ownership).

This creates a dilemma: if innovation is a fundamental driver of corporate success, how can the corporate governance mechanisms that lead to innovation not be the same mechanisms that lead to corporate success? We believe that the critical dynamics connecting these constructs are the specific individual characteristics of executives and directors. While the literature largely treats corporate governance as a menu of objective and observable metrics—board independence, executive compensation, anti-takeover provisions—the process of corporate governance is fundamentally one of human behavior. Yes, the objective and observable metrics can be proxies intended to capture the incentives or constraints that guide human behavior. However, the dynamics that connect these proxies to humans actually implementing corporate strategies and investments can be highly complex and nuanced.

We study these highly complex and nuanced dynamics by considering the social network relationships of executives and directors to understand how they might be related to innovation, as measured by the number of future patents and patent citations that a firm generates. We begin by analyzing the busyness of directors and the interlocking relationships between directors and boards. An interlocking board relationship exists when, for example, an executive of Company A serves as a director of Company B and an executive of Company B serves as a director of Company A. In theory, assuming a fixed supply of firms and directors, as directors serve on more and more boards, there is an increased likelihood that they will develop interlocking relationships with other firms' boards. The existing literature has found both costs and benefits from busy directors or interlocked directors. For example, Fich and Shivdasani (2006) find that busy directors lead to worse firm performance, while Field et al. (2013) find that busy directors help increase valuations for firms going public. Larcker et al. (2013) find that firms with well-connected directors enjoy greater longer-term risk-adjusted returns than less well-connected firms, while Fracassi and Tate (2012) find that directors with more external network ties to the CEO engage in more value-destroying acquisitions. We are the first to study these constructs simultaneously—busy directors and interlocked directors—in order to provide a complete picture of the impact that directors' social network relationships have on innovation.

Our results show that firms with busy boards innovate less and that firms with interlocked directors innovate more. These results are mitigated by the directors' other relationships: when directors are busy but not interlocked there is a negative impact on innovation, and when directors are interlocked but not busy there is a positive impact on innovation. However, neither of these dynamics dominates: when directors are both busy

and interlocked, the effects offset each other and there is no significant impact on innovation. These findings indicate indeed directors' social network and connections help improve firm innovation, plausibly due to the directors' learning and acquisition of insights, experience and expertise on innovative activities by serving on other firms' boards. However, this positive impact of network relationship on innovation has some limitations—if the directors are too busy or stretched out by serving on too many external boards, then they do not appear to be capable of leveraging all that they can learn or experience from their networks.

We then study director entrenchment, following Sapra et al. (2014) and Chemmanur and Tian (2018), to confirm that director entrenchment serves to protect the directors and firm investment policies from the short-term whims of the financial markets. We extend this prior literature, including additional measures of entrenchment, and compare these relationships to other corporate governance; by providing a more holistic analysis of how entrenchment can be measured, we present more robust results on how entrenchment impacts innovation. While entrenchment, measured with different anti-takeover measures and indices, has been found to be associated with worse firm performance and lower firm value using traditional, possibly short-term, measures of performance and value, we find that entrenchment is, indeed, beneficial to firm innovation. This result holds using anti-takeover provision indices and using several different measures of director tenure as proxies for structures that insulate directors from market pressure.

From there, we turn to director-specific expertise and experience. Directors are appointed to serve as both monitors and advisors; to the extent that firms can create value and competitive advantages through innovation and directors who facilitate (or support) investment in innovation would be seen as effective advisors. We first consider the current professional role of directors to analyze how individual director expertise impacts innovation. We find that directors who are currently serving as CEOs or Board Chairs at other firms are associated with less innovation at the sample firm, possibly either because they are too busy in their day job to provide effective advice on the board or because their expertise is at such a macro-level that they cannot appreciate the value of specific investments, such as innovation. Directors who are classified as financial experts based on Sarbanes–Oxley criteria neither help nor hurt innovation. While these directors should appreciate the long-term value–creation potential of innovation better than other directors, perhaps their role is confounded by concerns about risk mitigation. Then we focus on director age, conjecturing that directors at different ages will have different risk tolerances, incentives and career concerns that would result in them supporting different investment policies. We find a positive, but insignificant, relationship between director age and innovation. While younger directors may be less risk-averse and may have greater incentives to invest in the option value associated with innovation, these incentives appear to be offset by the role that tenure and professional experience play in supporting innovation.

Finally, we turn to two of the most traditional measures of general corporate governance: board structure and director ownership. Both board independence and director ownership have been found to be associated with better corporate governance, in general, so we investigated whether they are influential in leading a firm to generate more patents and patent citations. They are not. We hypothesize that they are such broad measures of governance that they cannot capture the intricate and unique benefits of something as specific as a firm's innovation strategy.

Overall, our results paint a picture of how directors add value to a firm's strategic innovation process. Informed and connected directors can add value and improve a firm's innovation strategy but only if they are not too busy or distracted to focus on their advisory role. The more entrenched and protected the directors are from the short-term demands of financial markets, the more liberated the directors will be to generate successful investment in innovation. Individual experience and expertise are also critical determinants of a firm being more successful in generating patents and patent citations. However, at the firm-level, broad measures of corporate governance—board independence and director

ownership—seem to be confounded by other dynamics and do not capture the value created by innovation.

This paper makes at least three key contributions to the literature. First, we provide the first comprehensive analysis of how different corporate governance mechanisms influence a firm's innovation success. Second, we show how directors' professional activities and networks produce tradeoffs in the boardroom. In particular, this study fills a gap in prior literature by examining, for the first time in the literature, the effect of board busyness on innovation and hence sheds new light on the role of board busyness in affecting firm investment decisions. We document a negative effect of busy boards on innovative outputs. Third, we show that certain mechanisms that have previously been shown to be associated with good corporate governance at a macro-level may not be effective in leading to long-term innovation. Prior studies only consider one governance metric at a time, naively assuming that each metric fully captures a firm's entire governance system; we improve upon this perspective by considering multiple measures of different governance dynamics and showing how they can interact within a firm's governance system. We attribute our findings to the fact that corporate governance is a highly nuanced construct; one size does not fit all, and different measures of corporate governance may explain very different aspects of firm performance. Thus, firms appear to utilize different corporate governance measures as their tools to attain specific goals regarding their strategic innovation process and success. Corporate governance is ultimately about relationships between human beings and who these humans are is what will determine how corporate governance is affected at each firm.

The rest of the paper proceeds as follows. The next section provides a literature review and introduces our hypotheses. Section 3 presents our data. Section 4 contains discussion and presentation of our empirical analyses. Section 5 provides a discussion of our results and the limitations of our study and Section 6 concludes.

2. Literature Review and Hypothesis Development

In this paper, we analyze the effects that corporate governance structures have on corporate innovation. This is the first study to provide a comprehensive analysis on how different corporate governance measures influence innovation and on how directors' professional relationships influence innovation. The purpose of this study is to better understand the tensions that boards face in their dual roles of monitoring and advising.

Shleifer and Vishny (1997) define corporate governance as "the ways in which suppliers of finance assure themselves of getting a return on their investment". Hart (1995) characterizes corporate governance as a system that facilitates how firms make decisions regarding resource allocation and the tradeoffs between incentives and risk-sharing. These tradeoffs, with the ultimate goal of maximizing firm value and returns to suppliers of capital, create a natural tension between the structures that firms choose and the decisions boards of directors make. In competitive markets, firms must innovate—in products, processes or otherwise—in order to succeed. How individual firms benefit from innovation is well-established in the finance and economics literatures. Kogan et al. (2017) estimate the private, company-level economic value that is created by patents; importantly, they explain that this economic value may or may not be correlated with the unique scientific value of any patent. They perform a quasi-event study looking at market value effects on days when companies receive patent grants. They estimate that the median value of a new patent is USD 3.2 million (measured in 1982 USD). Their results extend to more general measures of economic impact; they find that a one standard deviation increase in their innovation index is associated with a 1.6–6.5% increase in output and a 0.6–3.5% increase in total factor productivity over a 5-year horizon. Hall et al. (2005) estimate that each additional citation a patent receives is associated with a 3% increase in market value for the firm.

While the relationship between innovation and firm value is clear, we know that firms do not always make the investments necessary to create long-term firm value. Graham et al. (2005) survey 401 finance executives regarding their investment behavior; these executives

admit that they would avoid making long-term, positive net present value investments if doing so allowed the firm to meet or beat analyst forecast estimates in the short-term. Asker et al. (2015) show this behavior empirically, finding that publicly traded firms invest less and are less responsive to investment opportunities than similar privately held companies that are not accountable to short-term market discipline. If corporate governance is the system that provides a return on investment to the suppliers of capital, then corporate governance must be the oversight channel through which these investment policies are established.

Thus, studying the relationship between corporate innovation and the governance mechanisms that firms choose helps us understand how they attempt to provide this return on investment. One strand of the corporate governance and innovation literature has considered the relationships between corporate governance and innovation at the macro-level. O'Connor and Rafferty (2012) look at the relationship between governance and research and development expenses, using the Gompers et al. (2003) and Bebchuk et al. (2009) indices as their measures of governance. They find no relationship between these indices and research and development expenses, concluding that "corporate governance has little to no influence on innovative activity"; the "little" influence that they reference is a negative relationship in one of their models. That is, entrenchment is not bad for innovation and, if anything, it enhances innovation.

Sapra et al. (2014) corroborate this notion. They develop a model that predicts a U-shaped relationship between innovation and takeover pressure: greater innovation is generated in situations where anti-takeover laws are either very weak, so as to allow unobstructed innovation, or are very strong, so as to prevent external takeover pressure. In their empirical tests, they do find support for this non-monotonic relationship. Chemmanur and Tian (2018) also study the relationship between innovation and anti-takeover provisions and find a similar result: firms with greater anti-takeover provisions enjoy greater innovation as they are protected from the short-term pressures of the takeover market (and can make investments that might hurt short-term performance but lead to long-term value-creation). Manso (2011) focuses on the incentives required for executives and directors to be willing to invest in innovation. He shows that the optimal managerial incentive scheme focuses on the long-term: stock option awards with long-vesting periods, golden parachutes and managerial entrenchment. Balsmeier et al. (2017) show that independent boards of directors are associated with greater innovation, as measured by patents and citations.

Other work has studied the relationship between governance and innovation in specific situations. Chang et al. (2015) find that firms with more conservative financial reporting—measured using Khan and Watts' (2009) *C_Score*—have less innovation. This manifests through myopic managers feeling the pressure to deliver short-term performance and being reluctant to make long-term investments. He and Tian (2013) find that firms that are covered by a larger number of research analysts have less overall innovation and have less impactful innovation. This is consistent with findings by Chang et al. (2015) that conservatism, or perceived risk of loss or disappointment, leads to less innovation. Belloc (2011) shows that firms with greater CEO ownership, more director ownership and more employee directors generate more innovation. Wang and Zhao (2015) extend the ownership perspective and find that firm ownership matters for innovation, as hedge fund ownership increases both the quantity and quality of patents and commensurately increases firm value through this innovation effect.

Because corporate governance is ultimately a nexus of interpersonal relationships, prior work has studied how such relationships might impact corporate innovation. An et al. (2021) show that corporate innovation is positively related to board diversity; such boards are more willing to take risks that result in patents and patent citations. Chang and Wu (2020) find that well-connected boards generate more than 10-times the number of patents and citations that poorly connected boards generate. Mbanyele (2021) finds that staggered

boards, a popular, subversive way of entrenching directors, leads to less innovation across a sample of Asian firms.

From this work, it is clear that (a) investments in innovation require tradeoffs with other potential firm investments, and (b) understanding firm- and human-specific dynamics is critical to understanding how corporate governance influences innovation. Thus, in order to better understand how specific corporate governance mechanisms influence innovation at both the macro-level and with respect to individual director characteristics, we study this relationship within six different corporate governance constructs: board busyness, interlocked directors, entrenchment, director expertise, board structure and director ownership.

2.1. Director Busyness and Innovation

Fich and Shivdasani (2006) were among the first to focus on the general relationship between board busyness and firm performance. They studied the busyness of directors for firms in the Forbes 500 from 1989–1995 and found that firms with busy boards—those boards where a majority of outside directors hold three or more directorships—exhibited worse operating performance, lower market-to-book ratios and a lower likelihood of disciplinary CEO turnover following poor firm performance. Cashman et al. (2012) similarly find a negative relationship between board busyness and firm value using a more recent sample.

An extensive body of research has looked to better understand board busyness in specific situations. Ahn et al. (2010) find that firms with busy boards engage in more value-destroying acquisitions. Jiraporn et al. (2008) show that firms with busy boards are valued with a larger diversification discount. Falato et al. (2014) show that firms with busy boards suffer negative abnormal returns when a director or CEO dies, due to the expected sudden increase in director workload. Core et al. (1999) find that busy boards are associated with abnormally high CEO compensation.

Field et al. (2013) studied board busyness in firms going through initial public offerings (IPOs) from 1996–2008, with a focus on venture capital-backed IPOs. In this sample, they can distinguish between the monitoring costs and the advising benefits of having busy directors. They find the advising effect dominates: busyness is associated with higher market-to-book ratios in their sample. They also analyze a sub-sample of Forbes 500 firms, similar to Fich and Shivdasani's (2006) sample, finding that the benefits of busy boards do not extend to the largest, most mature firms. This suggests that different firms have different needs and that the optimal corporate governance structure will be unique for each firm. Chen and Guay (2018) use shareholder voting on director-specific issues to show that concerns about busy directors are less for directors with less time-consuming busyness and other professional responsibilities; for example, the negative relationship for busy directors is less severe for retired CEOs, while it is more extreme for directors who are still employed as full-time executives.

Innovation is a long-term process and a long-term investment. However, how board and director busyness influences innovation is uncertain; the existing research provides implications that board busyness could be either beneficial or detrimental to innovation. Board busyness could lead to directors being distracted monitors or it could lead to directors being more informed and effective advisors. We examine two alternative hypotheses to empirically study this relationship:

Hypothesis 1a. *Busy boards and directors are associated with less innovation.*

Hypothesis 1b. *Busy boards and directors are associated with more innovation.*

2.2. Interlocked Directors and Innovation

Directors with interlocking relationships have the potential benefit of bringing knowledge from other firms to the board but also the potential cost of being busy and distracted.

The literature on interlocked directors considers not just whether or not a director is interlocked but also the professional networks and the connections between firms and individual directors. In theory, given a fixed number of firms and a fixed supply of directors, as more directors become busy, they are likely to have more interlocked relationships with other firms. The literature is mixed on whether or not such relationships are beneficial for firms.

Fracassi and Tate (2012) find that directors with more network ties to the CEO—a more general measure than interlocking directorships—are associated with weaker governance; their firms engage in more value-destroying acquisitions and firm value increases when such directors leave the board. Devos et al. (2009) find that interlocked relationships compromise independence and create unobservable conflicts of interests; they find that firms with poor relative performance are more likely to have interlocked directors and that firms with more interlocked directors are associated with weaker CEO pay-performance sensitivity. Falato et al. (2014) show that the problems associated with director busyness are most pronounced for firms with more interlocked directors. Bowen et al. (2008) show that interlocked directors are associated with more accounting discretion, suggesting that interlocked directors are weaker monitors. Bizjak et al. (2009) find that firms with more network connections on the board are more likely to engage in option backdating.

However, other work highlights the benefits gained from the professional network connections associated with interlocking directorships. Larcker et al. (2013) find that firms with well-connected directors enjoy greater long-term risk-adjusted returns than less well-connected firms; further, they find that well-connected firms enjoy greater future growth that is not initially priced into stock prices. Cai and Sevilir (2012) find that firms with stronger network connections actually enjoy higher acquisition announcement returns. Hochberg et al. (2007) study network connections in the venture capital industry and find that better-networked venture capital firms and their portfolio firms enjoy better performance, at both the fund and portfolio company level. Helmers et al. (2017) find that board interlocks have significant and positive effects on R&D spending and patents generated using a recent sample of firms in India; these benefits accrue through information sharing.

While interlocked directors may be able to provide strategic insight that they gain from their professional relationships, it is uncertain whether these benefits will dominate the costs—through potential conflicts of interest and less focused monitoring—associated with directors being interlocked. Ex ante, the expected relationship is unclear; thus, we present two alternative hypotheses to capture the relationship between interlocked directors and innovation:

Hypothesis 2a. *Boards with more interlocking relationships are associated with more innovation.*

Hypothesis 2b. *Boards with more interlocking relationships are associated with less innovation.*

2.3. Entrenched Directors and Innovation

Gompers et al. (2003) created an index of 24 anti-takeover provisions to assess whether a firm's corporate governance structure is entrenched and manager friendly (the "dictator" firms) or if it was open and shareholder friendly (the "democracy" firms); they found that less entrenched and more democratic corporate governance structures were associated with higher firm value, profits and stock returns. Bebchuk et al. (2009) show that using only six of the twenty-four provisions yield similar results that entrenchment is associated with lower firm value, while the other eighteen provisions are unrelated to firm value. Gompers et al. (2003), however, also found that shareholder-friendly, non-entrenched corporate governance structures were associated with the firms making fewer acquisitions and having lower capital expenditures overall. This suggests there can be a difference between the short-term effects and long-term effects of entrenchment.

Sapra et al. (2014) develop a model that predicts a U-shaped relationship between innovation and takeover pressure: more innovation occurs in situations where anti-takeover

laws are either very weak, so as to allow unobstructed innovation, or are very strong, so as to prevent external takeover pressure. They further find empirical support for this non-monotonic relationship. Chemmanur and Tian (2018) also study the relationship between innovation and anti-takeover provisions and find a similar result: firms with more anti-takeover provisions enjoy superior innovation as they are protected from the short-term pressures of the takeover market and are allowed to make long-term investments.

These findings are most interesting because the prior literature on the relationship between entrenchment and firm value or firm performance shows a negative relationship. Bebchuk and Cohen (2005), Faleye (2007) and others have studied the effects of boards being—or becoming—entrenched; in these cases, they use classified boards as the mechanism through which boards become entrenched. In general, they find that entrenchment leads to lower firm value because it insulates the board and management from market discipline.

Other work has considered alternative dynamics that can lead to boards and management being entrenched and potentially immune to market discipline. He and Tian (2013) study the relationship between financial analyst coverage and innovation, and they find that firms covered by more analysts produce less innovation. While analyst coverage may be beneficial in terms of information transparency and price discovery, the short-term pressures associated with greater scrutiny lead boards to be more risk-averse and to invest less in innovation. Zhang (2017) suggests that entrenchment through CEO–Chair duality can be beneficial to firms with good governance and high product market competition as it provides a more efficient management structure; as such, boards need to evaluate their own specific needs and structures when deciding whether to consolidate or separate the CEO and Board Chair positions.

Ultimately, it remains an empirical question as to whether or not board entrenchment will induce more or less corporate innovation. Innovation is a long-term investment, similar to acquisitions in nature and purpose, so it may be that entrenchment leads to more innovation. Alternatively, entrenched corporate governance structures may foster an insulated culture of accountability that avoids innovation. Thus, we present two alternative hypotheses:

Hypothesis 3a. *Entrenched directors are associated with more innovation.*

Hypothesis 3b. *Entrenched directors are associated with less innovation.*

2.4. Director Experience and Innovation

Given their dual roles of monitoring and advising, there is no doubt that directors' professional experience and expertise is critical; in theory, that is exactly why they serve on the board. However, "experience" and "expertise" can be very difficult to measure in practice. Duchin et al. (2010) show that outside director effectiveness depends on their knowledge about the firm—and how costly it is for them to gain the knowledge necessary to be an effective monitor; outside directors are most effective when the costs to gaining knowledge about the firm are low and least effective when those costs are high. Fich (2005) finds that firms experience positive abnormal returns upon announcing they are adding an outsider CEO to the board of directors but negative abnormal returns for all other director announcements; he further finds that appointing outside CEOs to the board improves long-term operating performance. Fich and White (2005) point out that nearly one in seven large company boards has reciprocating CEO directors, where executive directors of different firms sit on the other's board, in a sample from the early 1990s; they find that these appointments benefit the individuals more than the firms they serve. More recently, Fahlenbrach et al. (2010) study the effects of firms appointing outside CEOs to the board. They show that the stock market reacts favorably to a firm announcing the appointment of an outside CEO to the board; however, they do not find any significant differences in operating performance or decision-making following these appointments.

In 2002, The Sarbanes–Oxley Act (SOX) required public companies to disclose whether they have a "financial expert" on the audit committee. The definition of "financial expert" is very broad, allowing for both accounting and finance professionals to be classified as experts. DeFond et al. (2005) specifically study the addition of financial experts to the audit committee, using a pre-SOX sample. They find that firms experience a positive abnormal return when they add a finance expert with an accounting background but no stock price reaction when firms add a finance expert without an accounting background. Güner et al. (2005) study how financial experts serving on the board impact a firm's investment decisions, finding that financial experts on the board significantly affect the firm's investment policies but not to the benefit of shareholders. Firms with more finance expert directors make fewer value-creating internal investments and make more value-destroying acquisitions.

Another construct that can proxy for director experience is director age. There is little research on the influence of director age, but a considerable number of works have studied the impact of CEO age. Jenter and Lewellen (2015) find that firms led by younger CEOs have better governance structures and are more likely to make acquisitions. Similarly, Kim (2013) shows that young CEOs make more large acquisitions because such acquisitions lead to large and permanent increases in salary for the CEO. Thus, large acquisitions represent a real option that can lead to significant benefits for the CEO. These dynamics and incentives for CEOs should apply to directors: presumably, younger directors would want to be associated with growth, acquisitions and large-scale investments in order to increase their career opportunities and permanent earning potential. Could investing in innovation be a similar real option for CEOs and directors?

We expect the experience of directors to significantly impact a firm's innovation, but the specific impact will depend on the nature of that expertise. Given the findings in the prior literature regarding directors' professional experience, we present three related hypotheses:

Hypothesis 4a. *Boards with more CEO directors will generate less innovation.*

Hypothesis 4b. *Boards with more finance expert directors will generate less innovation.*

Hypothesis 4c. *Boards with younger directors will generate more innovation.*

2.5. Board Structure and Innovation

As discussed above, Duchin et al. (2010) provide clear evidence that board independence matters for firms. Balsmeier et al. (2017) show that greater innovation follows boards moving to having a majority of independent directors and that these results are most pronounced for firms for which innovation is most important (firms with high R&D expenditures). These benefits may come from the increased information sharing and advice that outside directors can provide; conceptually, this is similar to the benefits that can be gained through interlocking director relationships. Bhagat and Bolton (2013) find a negative relationship between firm performance and director independence prior to 2002 but a positive relationship after 2002 as SOX and other factors led to an increased focus on director independence and quality. Knyazeva et al. (2013) also find a positive relationship between board independence and firm performance, uniquely controlling for each firm's local labor market. Additionally, in their study looking at the impact of the sudden death of independent directors, Nguyen and Nielsen (2010) find that the stock market reacts negatively to the sudden death of an independent director.

Given the preponderance of current research finds that greater director independence is associated with better performance, more innovation and higher firm value, we expect the same to hold in our study of the effect of board independence on innovation. On the contrary, a more independent board may entail more intense monitoring and discipline that can lead managers to pursue short-term performance goals (e.g., in terms of enhanced tran-

sient earnings and stock price) at the sacrifice of long-term valuable but risky projects, such as innovation. Hence, we also expect a negative association between board independence and innovation. These conjectures lead to the following hypothesis:

Hypothesis 5a. *More independent boards are associated with more innovation.*

Hypothesis 5b. *More independent boards are associated with less innovation.*

2.6. Director Ownership and Innovation

In the spirit of Jensen and Meckling (1976), director stock ownership is the ultimate moderator of principal-agent costs. Bhagat and Bolton (2013) provide empirical evidence that greater director ownership is a critical determinant of long-term value creation. As innovation is a uniquely long-term investment, we expect directors to value the long-term, but risky, relation between innovation and their personal stock holdings in the firm. Bushee (1998) shows that mangers are less likely to cut research and development expenditures when institutional ownership is high. Aghion et al. (2013) develop a theoretical model to test this relationship, and they find a similar result, showing that greater institutional ownership is associated with more innovation, as measured by cite-weighted patents. Belloc (2011) finds that firms with greater CEO ownership, more director ownership and more employee directors enjoy greater innovation. Thus, the prior literature is generally consistent in suggesting that greater director ownership should be an effective tool to mitigate any principal-agent conflicts; given this, we expect to see a positive relationship between director ownership and innovation.

Hypothesis 6a. *Directors with greater stock ownership are associated with more innovation.*

Hypothesis 6b. *Directors with greater stock ownership are not associated with more innovation.*

3. Data

We construct our innovation variables from the patent and citation database compiled by Kogan et al. (2017) (henceforth KPSS data) and various governance variables from the Institutional Shareholder Services database (ISS, previously RiskMetrics and IRRC). We obtain firm financial information from Compustat, stock return data from the Center for Research in Security Prices (CRSP), executive compensation and ownership data from ExecuComp, and institutional shareholder ownership from Thomas Reuters' 13f data. Our sample period starts in 1996 when ISS data became available and ends in 2010 as the KPSS data ended. The downside to using the KPSS data is that it has not been updated since 2010. However, the KPSS is the most complete database of patent and citation data for U.S. firms; further, by using these data, we can directly compare our results to prior studies performed within the same sample period, allowing for the more direct comparison of the governance and innovation relationships. We require at least one year lead-lag in our regression analysis; therefore, the innovation data (dependent variables) range from 1997–2010 and the board governance data, along with the control variables, range from 1996–2009. To mitigate sample selection bias, we follow Atanassov (2013) and He and Tian (2013) and assign zero value to firm-years with missing patent or R&D data and include them in our regressions. The Appendix A provides detailed variable definitions.

3.1. Innovation Measures

To measure corporate innovation, we follow Trajtenberg et al. (1997), Hall et al. (2002), Hall (2005) and Wang and Zhao (2015) and employ several metrics, including the number of patents filed per year (*Pats*) and the number of citations received in life on all of the patents filed for in each year (*Cites*); to control for industry trend and truncation bias in patent data, we also use bias-adjusted measures, based upon the U.S. Patent and Trademark

Office's (USPTO) technological classifications of patent quantity and citations (*PatsTN* and *CitesTN*, respectively).

More specifically, *Pats* is the total number of patents filed for by a firm (and ultimately granted) in a calendar year. Consistent with Hall et al. (2002), the relevant year is the application or filing year, which is closer to the timing of the actual innovation rather than grant year. Then *Pats* is further divided by the average number of patents applied for across all firms in the same application year and the same USPTO technological class (*PatsTN*) to correct for the truncation bias in patent grants. The truncation bias arises as patents have on average a two-year lag from application to grant date, and some patents that have been applied for may not have yet entered into the sample. *Ln(1 + Pats)* is the natural logarithm of one plus *Pats* and *Ln(1 + PatsTN)* is the natural logarithm of one plus *PatsTN*, which we use in the regressions as many firms have no patents in a given year.

In addition to patent quantity, we also construct measures for patent quality and impact. *Cites* is the total number of future citations received in life on all patents applied for by (and ultimately granted to) a firm in an application year. Patents that are more heavily cited are viewed as having more impact or being more important. *CitesTN* equals *Cites* scaled by the citations received on all patents filed in the same USPTO class and the same application year to account for the fact that patents that are granted earlier may have received more citations than recent ones. In our analyses, we use Ln(1 + Cites) and *Ln(1 + CitesTN)* as the logarithms of one plus *Cites* and *CitesTN*, respectively, as many firms do not produce any cites in a year.

3.2. Corporate Governance Measures

Corporate governance and board measures are retrieved from the Institutional Shareholder Services database. The corporate governance measures that we use within each of our six constructs follow from the existing literature. Refer to the Appendix A for more detail on each of these variables.

To measure the busyness of boards and directors, we use three primary variables. First, we calculate the percentage of directors who are on three or more other boards for each firm-year, derived from Fich and Shivdasani (2006). Second, we use the natural logarithm of the average number of other boards directors serve on, as in Ferris et al. (2003). Finally, following Fich and Shivdasani (2006), we measure board busyness using an indicator variable equal to one if at least 50% of the independent, non-affiliated directors are on three or more other boards and equal to zero otherwise.

To measure interlocking director relationships, we use the percentage of directors who have an interlocking relationship, following Institutional Shareholder Services classification; this is consistent with the prior literature, including Bizjak et al. (2009), Devos et al. (2009) and others.

To measure director entrenchment, we consider three different types of corporate governance variables. First, we consider director tenure as a proxy for entrenchment with the average tenure of all directors, the percentage of directors who have more than 15 years of service on the board and the percentage of directors who have less than 5 years of service on the board. Second, following Sapra et al. (2014) and Chemmanur and Tian (2018), we use anti-takeover provisions as one measure of entrenchment; we use both the Bebchuk et al. (2009) E-Index and the Gompers et al. (2003) G-Index. Finally, we use an indicator variable equal to one the CEO is also the board chair and zero otherwise (CEO–Chair duality).

To measure director experience, we consider different variables to correspond with the three versions of Hypothesis 4. First, we consider the professional responsibilities of directors; we use the percentage of directors who are CEOs of other firms and the percentage of directors who are Board Chairs at other firms (from Fahlenbrach et al. (2010)). Second, following the work of DeFond et al. (2005) and Güner et al. (2005), we use the percentage of directors classified as finance experts to measure director expertise. Finally, following Kim (2013) and Jenter and Lewellen (2015), we consider average director age to measure director experience.

To measure board structure, we consider the percentage of directors on the board who are classified as independent. Following Duchin et al. (2010) and Knyazeva et al. (2013), the percentage of directors who are independent is a highly informative measure of board structure; thus, we believe that this measure can fully capture board structure.

Finally, to measure board ownership, we consider three different variables. First, we use the median percentage of stock owned by board members. Second, following Bhagat and Bolton (2013), we use the median dollar value of stock owned by a firm's directors (in natural logarithm form). We calculate this number using the number of shares that each director beneficially owns, as specified in the firm's annual proxy statement, multiplied by the year-end stock price. Finally, we use the percentage of directors who do not own any company stock as a measure of director ownership, as it may proxy for a firm's culture of ownership.

3.3. Control Variables

In all of our regression models, we use a standard series of control variables to control for firm- and industry-specific characteristics. We control for firm size using the market value of equity (*Ln(MV)*) for investment policies using research and development expenditures (*R&D/Assets*), capital expenditures (*CAPX/Assets*) and fixed assets (*PPE/Assets*) and for firm performance using return on assets (*ROA*), sales efficiency (*Ln(Sales/Emp)*) and Tobin's q (*Q*). We further control for capital structure (*Debt/Assets*), liquidity (*Cash/Assets*), industry concentration using Herfindahl Index (HI and HI2), firm age (*Ln(Firm Age)*) and overall corporate governance environment using institutional ownership (*Institutional Own.*), insider stock ownership (*Insider Ownership*) and executive compensation policy (*Equity/Total Pay*). We use firm and year fixed effects in all regressions. Full variable definitions are provided in the Appendix A.

3.4. Summary Statistics

Summary statistics for our innovation and corporate governance variables are presented in Tables 1 and 2; the variables are defined in Appendix A. Panel A of Table 1 presents our innovation variables. On average, firms generate 26.4 patents a year in total and 4.8 patents a year when adjusted for the total number of patents files in the same year and the same technological class. However, these statistics are highly skewed; the number of patents generated is equal to zero in more than half of the firm-years (this is consistent with the R&D spending numbers in Table 1, Panel C). The average firm generates 190.9 patent citations in the future, while the average patent receives 1.49 future citations.

Panel B presents the statistics for our corporate governance variables. The average board of directors has nine members, 72% of whom are independent; the average director is 60.3 years old and has 10.4 years of service; 22% of directors have more than 15 years of service and 21% have fewer than 5 years of service. The average firm has a Gompers et al. (2003) G-Index of 9.4 and a Bebchuk et al. (2009) E-Index of 1.6. Regarding professional experience, 9% of directors are actively employed as the CEO of another firm, 8% are actively serving as the board chair at another firm and 14% meet the Sarbanes–Oxley criteria for being a financial expert. With respect to director activity and professional relationships, 10% of the directors are busy (on three or more other boards), 7% are busy outside directors, 1% have interlocking relationships and the average director serves on 0.87 other boards (1.87 boards total).

In Panel C of Table 1, we can see that the firms in our sample are large firms, with average market capitalization of USD 8.4 billion and average assets of USD 7.4 billion. Most of the other control variables show characteristics that we would expect with a sample of S&P 1500 firms: leverage of 23%, institutional ownership of 61%, insider ownership of 3% and a Tobin's q of 2.02. Interestingly, more than half of our firms do not report any research and development expenditures (*R&D/Assets*); while this does not necessarily mean that these firms are not investing in innovation and patents, it does suggest that our sample of firms is very diverse in the investments they make and how they might address innovation.

Table 2 looks more specifically at these innovation variables, by year and by industry. The mean number of future patents and future citations is the highest in the late-1990s and early-2000s; the number of future patents and citations decreases over the decade of the 2000s. Panel B presents the industry distribution using the Fama–French 48 industry classifications. Consumer goods, medical equipment, construction materials, machinery, electrical equipment, aircraft, shipbuilding and shipping containers, precious metals, computers, chips and measuring and control equipment are the most active innovators in terms of future patents and citations. Importantly, more than half of the 48 industries have median values equal to zero. Due to the extreme heterogeneity in innovation generation across time and across industries, these statistics show why we control for both year and industry factors in all of our analyses.

Table 1. Summary Statistics. This table provides summary statistics on the key Innovation, Governance and control variables. All variables except binary variables are winsorized at the upper and lower 1% level. Panel A presents the corporate innovation variables; Panel B presents the corporate governance variables; Panel C presents the firm-level control variables. All variables are defined in the Appendix A.

Panel A: Innovation Variables in Year t + 1 (1997–2010)							
	N	Mean	Std Dev	Min	P25	Median	P75	Max
Pats	13,621	26.36	157.55	0	0	0	3	4422.00
$Pats_{TN}$	13,621	4.79	24.33	0	0	0	0.71	684.17
Cites	13,621	190.93	1838.02	0	0	0	2	95,000.00
$Cites_{TN}$	13,621	26.21	159.93	0	0	0	1.54	4357.32
Cites per Patent	13,621	1.49	5.09	0	0	0	0.48	157
$Cites_{TN}$ per Patent	13,621	0.34	0.84	0	0	0	0.39	20.8
Ln (1 + Pats)	13,621	0.94	1.58	0	0	0	1.39	5.86
Ln (1 + $Pats_{TN}$)	13,621	0.53	1.04	0	0	0	0.54	4.23
Ln (1 + Cites)	13,621	1.08	2.05	0	0	0	1.1	7.7
Ln (1 + $Cites_{TN}$)	13,621	0.83	1.57	0	0	0	0.93	5.85
Panel B: Corporate Governance Variables in Year t (1996–2009)								
	N	Mean	Std Dev	Min	P25	Median	P75	Max
Director Busyness:								
Busy Directors	8553	0.1	0.11	0	0	0.09	0.17	0.44
Busy Outside Directors	8553	0.07	0.09	0	0	0	0.13	0.38
Busy Insider Directors	8553	0.01	0.02	0	0	0	0	0.14
# of Other Boards	8553	0.87	0.48	0	0.5	0.82	1.17	2.25
Director Interlock:								
Interlocked Directors	8564	0.01	0.03	0	0	0	0	0.14
Interactions between Director Busyness and Interlocks:								
Busy Non-Interlocked Directors	8553	0.1	0.11	0	0	0.09	0.17	0.43
Interlocked Non-Busy Directors	8553	0.01	0.03	0	0	0	0	0.15
Busy and Interlocked Directors	8564	0	0.01	0	0	0	0	0.06
Director Entrenchment:								
Director Tenure	8544	10.43	3.99	3	7.5	9.88	12.71	22.67
Tenure > 15 Yrs	8553	0.22	0.18	0	0.1	0.2	0.33	0.71
Tenure < 5 Yrs	8553	0.21	0.17	0	0.1	0.2	0.33	0.8
BCF E-Index	11,371	1.56	1.07	0	1	2	2	4
GIM G-Index	11,371	9.42	2.48	4	8	9	11	15
CEO-Chair Duality	8562	0.37	0.48	0	0	0	1	1
Director Experience:								
CEO of Other Firm	8564	0.09	0.1	0	0	0.08	0.14	1
Chair of Other Firm	8564	0.08	0.09	0	0	0	0.13	1
Financial Expertise	2675	0.14	0.14	0	0	0.11	0.23	0.5
Director Age	8562	60.25	4.23	48.75	57.63	60.43	63	71
Board Structure:								
Board Independence	8564	0.72	0.15	0.33	0.63	0.73	0.82	1
Director Ownership								
%Median Ownership	8561	0.01	0.03	0	0	0	0	0.26
Median Dollar	8561	2,000,000	3,000,000	7	490,000	1,000,000	2,100,000	20,000,000
Median Shares	8561	64,000	93,000	4537	21,000	36,000	65,000	640,000
%Shares Zero	8561	0.05	0.08	0	0	0	0.1	0.33

Table 1. *Cont.*

Panel C: Control Variables in Year t (1996–2009)								
	N	Mean	Std Dev	Min	P25	Median	P75	Max
MV (USD mn)	13,621	8402.53	24,000.00	7.79	763.4	1998.14	5762.10	500,000.00
Sales (USD mn)	13,621	6313.52	18,000.00	0.18	671.28	1742.80	5267.00	430,000.00
Assets (USD mn)	13,621	7444.01	21,000.00	10.23	701.66	1921.07	5984.40	480,000.00
R&D (USD mn)	13,621	145	627.5	0	0	0	52.35	12,000.00
Employees (000)	13,621	24.65	69.47	0.01	2.45	7.1	21.5	2100.00
Ln (MV)	13,621	7.71	1.5	3.43	6.64	7.6	8.66	11.54
R&D/Assets	13,621	0.03	0.05	0	0	0	0.04	0.42
Ln (Sales/Emp)	13,621	5.59	0.84	3.11	5.09	5.52	6.04	7.98
CAPX/Assets	13,621	0.06	0.05	0	0.02	0.04	0.07	0.31
PPENT/Assets	13,621	0.3	0.23	0	0.11	0.23	0.44	0.88
ROA	13,621	0.14	0.1	−0.59	0.09	0.14	0.19	0.43
Debt/Assets	13,621	0.23	0.18	0	0.07	0.22	0.34	0.92
Cash/Assets	13,621	0.14	0.17	0	0.02	0.07	0.2	0.9
Q	13,621	2.02	1.28	0.75	1.23	1.6	2.32	8.66
HI	13,621	0.23	0.19	0.03	0.09	0.18	0.31	1
HI^2	13,621	0.09	0.16	0	0.01	0.03	0.09	1
Firm Age	13,621	26.3	20.86	0	10	20	37	84
Institutional Own.	13,621	0.61	0.34	0	0.45	0.7	0.85	2.44
Insider Own.	13,621	0.03	0.07	0	0	0.01	0.02	0.4
Equity/Total Pay	13,621	0.52	0.26	0	0.34	0.56	0.73	0.94

Table 2. Sample Distribution of Innovation Variables by Year and Industry. This table provides sample distribution of innovation variables by year (Panel A) and Fama–French 48 industry (Panel B). All except binary variables are winsorized at the upper and lower 1% level. Variables are defined in the Appendix A.

		Patents		**Cites**	
	N	**Mean**	**Median**	**Mean**	**Median**
Panel A: Distribution by Year					
1997	501	60.22	1.00	1123.82	6.00
1998	501	60.14	2.00	959.13	0.00
1999	494	63.74	1.00	853.27	0.00
2000	503	65.33	1.00	674.66	0.00
2001	526	61.89	1.00	461.50	0.00
2002	722	56.18	1.00	314.34	0.00
2003	748	53.23	0.00	191.84	0.00
2004	1433	26.93	0.00	66.57	0.00
2005	1427	24.48	0.00	36.78	0.00
2006	1232	19.11	0.00	18.32	0.00
2007	1284	12.16	0.00	7.17	0.00
2008	1408	5.29	0.00	2.07	0.00
2009	1432	0.92	0.00	0.27	0.00
2010	1410	0.00	0.00	0.00	0.00
Panel B: Distribution by FF 48 Industry					
1 Agriculture	37	27.38	0.00	55.59	0.00
2 Food Products	320	3.26	0.00	12.44	0.00
3 Candy and Soda	47	0.06	0.00	0.13	0.00
4 Beer and Liquor	85	2.85	0.00	17.35	0.00
5 Tobacco Products	38	9.92	1.50	87.84	0.00
6 Recreation (Toys)	83	15.81	4.00	88.10	4.00
7 Entertainment	157	3.07	0.00	16.96	0.00
9 Consumer Goods	98	93.64	7.00	512.37	8.00
10 Apparel	160	0.06	0.00	0.09	0.00
11 Healthcare	249	0.06	0.00	0.03	0.00
12 Medical Equipment	375	22.07	2.00	277.40	0.00
16 Textiles	53	4.66	0.00	7.60	0.00
17 Construction Materials	1847	23.44	0.00	116.46	0.00
18 Construction	207	4.06	0.00	19.39	0.00
19 Steel Works	241	9.71	0.00	56.59	0.00
20 Fabricated Products	24	0.71	0.00	0.83	0.00
21 Machinery	574	30.05	3.00	197.16	1.50

Table 2. *Cont.*

	N	Patents		Cites	
		Mean	Median	Mean	Median
Panel B: Distribution by FF 48 Industry					
22 Electrical Equipment	227	23.30	2.00	157.16	0.00
23 Automobiles and Trucks	56	9.36	0.00	62.84	0.00
24 Aircraft	290	66.41	2.00	265.90	0.00
25 Shipbuilding, Railroad Equipment	117	115.65	19.00	505.61	10.00
26 Defense	28	8.25	0.50	48.29	0.00
27 Precious Metals	40	65.85	4.00	360.90	2.00
28 Non-Metallic and Industrial Metal Mining	37	0.19	0.00	0.30	0.00
29 Coal	71	0.54	0.00	0.87	0.00
30 Petroleum and Natural Gas	32	0.00	0.00	0.00	0.00
31 Utilities	596	8.92	0.00	80.74	0.00
32 Telecom	973	0.14	0.00	0.78	0.00
33 Personal Services	398	16.90	0.00	85.36	0.00
34 Business Services	169	0.08	0.00	2.11	0.00
35 Computers	1393	40.07	0.00	274.55	0.00
36 Electronic Equipment (Chips)	559	93.35	3.00	953.09	1.00
37 Measuring and Control Equipment	924	100.82	6.50	844.06	3.00
38 Business Supplies	303	22.55	4.00	94.78	2.00
39 Shipping Containers	315	29.67	1.00	222.13	0.00
40 Transportation	80	6.43	0.00	47.81	0.00
41 Wholesale	417	0.44	0.00	2.20	0.00
42 Retail	489	1.17	0.00	8.39	0.00
43 Restaurants, Hotels, Motels	1068	0.23	0.00	0.74	0.00
44 Banking	291	0.26	0.00	0.05	0.00
45 Insurance	5	0.00	0.00	0.00	0.00
46 Real Estate	85	0.04	0.00	0.66	0.00
48 Other	63	7.17	0.00	17.41	0.00

4. Empirical Results

4.1. Methodology

Innovation is an expensive and long-term investment. Innovation is risky. Firms must be willing to take these risks in order to create value for the firm—potentially through low-probability, high-return investments. Additionally, boards of directors must (somehow) be incentivized to focus on the long-term rather than the short-term. Understanding the tradeoffs firms make as they choose their corporate governance structures is the natural evolution of corporate governance research. As the previous literature has shown, for example, there are situations where busy boards can be beneficial and there are situations where busy boards can be detrimental; similarly, boards with strong network connections and interlocking relationships have been shown to be beneficial and detrimental to firms in other situations. The purpose of this study is to disentangle these confounding effects—between busyness, interlocking relationships and other corporate governance constructs—in the specific context of corporate innovation.

Our analysis focuses on the interrelationships between these dynamics. Our primary empirical model studies how these corporate governance dynamics impact corporate innovation:

$$Innovation_{i,t+1} = \alpha + \beta Governance_{i,t} + \theta Controls_{i,t} + \varepsilon$$

We run ordinary least squares (OLS) regressions with the above model for our six hypotheses, regressing our four measures of Innovation on different measures of Governance. While it is certainly possible that specific directors may be attracted to firms that are already innovative, leading to concerns about endogeneity and reverse causality, it is not obvious that the specific types of directors we study would be attracted to firms that are already innovative; that is, it is not clear that busy directors, interlocked directors, independent directors or CEO directors would disproportionately be attracted to firms with higher levels of innovation. Further, while it may be conceptually possible that certain types of directors may be attracted to firms that are already innovative, any concerns about endogeneity and simultaneity bias should be reduced because we are considering the effect of current Gover-

nance on future Innovation. All regression models include firm and year fixed effects, plus industry Herfindahl indices, to control for any unobservable, time-invariant, firm-specific characteristics and are estimated using standard errors adjusted based on the Huber–White sandwich estimate and clustered by firm.

4.2. Director Busyness and Innovation

Table 3 presents the results of our analysis of Hypothesis 1 on the relationship between director busyness and firm innovation. Our primary variable of interest is *Busy Directors*, or the percentage of directors who are on three or more other boards in Panel A. We find a negative and significant relationship; busy directors are associated with fewer future patents and fewer future citations. In Panel B, we study *Busy Outside Directors* (defined as *Busy Independent Directors*); again, we see a significant and negative relationship across all measures of innovation. In Panel C, we only consider *Busy Inside Directors* (or *Busy Employee Directors*); here, we note that the relationship is positive but insignificant, except with respect to the *Ln(1 + Cites)* variable, which is significant at a 10% level. In Panel D, rather than using the percentage of directors who are busy as the primary explanatory variable, we consider the average number of boards that directors serve on as the measure for director busyness. The relationship between this measure of busy directors and innovation is also negative, supporting the hypothesis that busy directors are associated with less innovation. Thus, we conclude that our evidence supports the prediction of Hypothesis 1a, that busy boards and directors are too busy to focus on the firm and, thus, are associated with less generation of productive innovation.

Table 3. Regressions of Innovation on Director Busyness. This table presents regression results of Innovation on various measures of Director Busyness. Panel A examines Busy Directors, defined as the percentage of directors who are on three or more other boards (not including the sample firm); Panel B examines Busy Outside Directors, defined as the percentage of independent directors who are on three or more other boards; Panel C examines Busy Insider Directors, defined as the percentage of employee directors who are on three or more other boards, and Panel D examines Ln (# of Other Boards), defined as the natural logarithm of the average number of other boards that directors serve on. Control variables are omitted for brevity in Panels B, C and D. All regressions contain firm and year fixed effects. All except binary variables are winsorized at the upper and lower 1% levels. Full variable definitions are provided in the Appendix A. T-statistics are reported in parentheses. Standard errors are adjusted based on the Huber–White sandwich estimate of variances and are clustered by firm. *** indicates significance at the 1% level, ** 5% and * 10%.

Panel A: Busy Directors				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Busy Directors	**−0.2686 ** **	**−0.2204 *** **	**−0.3782 ** **	**−0.3149 *** **
	(−2.46)	**(−2.94)**	**(−2.25)**	**(−2.60)**
Ln (MV)	0.0784 *	0.0573 *	0.1113	0.0721
	(1.87)	(1.88)	(1.61)	(1.52)
R&D/Assets	−0.6007	0.0851	0.3949	−0.7285
	(−0.68)	(0.14)	(0.27)	(−0.65)
Ln (Sales/Emp)	0.1781 **	0.1086 *	0.3552 **	0.2162 **
	(2.22)	(1.88)	(2.52)	(2.26)
CAPX/Assets	−0.6699	−0.7121 ***	−1.3304 **	−0.8839 *
	(−1.61)	(−2.68)	(−2.02)	(−1.94)
PPENT/Assets	1.7821 ***	1.0385 ***	2.9506 ***	1.7568 ***
	(6.45)	(5.30)	(6.50)	(5.74)
ROA	−1.1075 ***	−0.6651 ***	−1.8892 ***	−1.3568 ***
	(−4.31)	(−3.92)	(−4.41)	(−4.71)
Debt/Assets	−0.0101	−0.0119	0.0676	−0.0318
	(−0.06)	(−0.10)	(0.23)	(−0.16)
Cash/Assets	0.1317	−0.0489	−0.0302	0.1242
	(0.73)	(−0.40)	(−0.10)	(0.60)

Table 3. *Cont.*

Panel A: Busy Directors				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Q	0.0825 ***	0.0451 **	0.1858 ***	0.1170 ***
	(3.25)	(2.49)	(4.20)	(3.96)
HI	0.5536	0.5450	1.2175	0.6048
	(0.99)	(1.34)	(1.32)	(0.98)
HI^2	−0.5669	−0.5674	−1.3031	−0.6932
	(−1.05)	(−1.44)	(−1.39)	(−1.15)
Ln (Firm Age)	0.5170 ***	0.3818 ***	0.6167 **	0.4220 ***
	(3.75)	(3.65)	(2.50)	(2.67)
Institutional Own.	0.0496	0.0573	0.2403	0.1031
	(0.45)	(0.73)	(1.19)	(0.80)
Insider Ownership	−0.5296	−0.5123 **	−1.0368	−0.7394 *
	(−1.40)	(−2.14)	(−1.58)	(−1.92)
Equity/Total Pay	0.0590	0.0105	0.1630 *	0.0823
	(1.13)	(0.31)	(1.92)	(1.40)
Constant	−3.8613 ***	−2.6406 ***	−6.2157 ***	−3.8029 ***
	(−5.13)	(−4.96)	(−4.90)	(−4.49)
Observations	8596	8596	8596	8596
R-squared	0.335	0.278	0.399	0.287
Firm and Year FE	Yes	Yes	Yes	Yes
Panel B: Busy Outside Directors				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Busy Outside Directors	**−0.2396 ** **	**−0.2041 ** **	**−0.3404 * **	**−0.2970 ** **
	(−2.07)	**(−2.58)**	**(−1.95)**	**(−2.34)**
Observations	8596	8596	8596	8596
R-squared	0.335	0.278	0.398	0.287
Firm and Year FE	Yes	Yes	Yes	Yes
Panel C: Busy Insider Directors				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Busy Insider Directors	**0.5577**	**0.4067 ***	**0.5973**	**0.3833**
	(1.64)	**(1.72)**	**(1.04)**	**(0.89)**
Observations	8596	8596	8596	8596
R-squared	0.334	0.277	0.398	0.286
Firm and Year FE	Yes	Yes	Yes	Yes
Panel D: Ln (# of Other Boards)				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Ln (# of Other Boards)	**−0.1177 *** **	**−0.0822 *** **	**−0.1490 *** **	**−0.1217 *** **
	(−6.55)	**(−6.85)**	**(−5.29)**	**(−5.82)**
Observations	8596	8596	8596	8596
R-squared	0.334	0.277	0.398	0.286
Firm and Year FE	Yes	Yes	Yes	Yes

4.3. Interlocked Directors and Innovation

Table 4 presents the results of the relationship between director interlocks and innovation. Across all four measures of innovation, we notice positive and significant relationships: boards with more *Interlocked Directors* generate more patents and citations. This provides support for Hypothesis 2a. These results are consistent with Helmers et al. (2017); interlocked directors benefit firm innovation through knowledge transmission.

Table 4. Regressions of Innovation on Director Interlocks. This table presents regression results of Innovation on Interlocked Directors, defined as the percentage of directors with any interlocking relationship with another board. All regressions contain firm and year fixed effects. All except binary variables are winsorized at the upper and lower 1% levels. Full variable definitions are provided in the Appendix A. T-statistics are reported in parentheses. Standard errors are adjusted based on the Huber–White sandwich estimate of variances and are clustered by firm. *** indicates significance at the 1% level, ** 5% and * 10%.

	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Interlocked Directors	**0.5230 ** **	**0.4066 ** **	**0.9382 ** **	**0.7693 *** **
	(2.03)	**(2.38)**	**(2.25)**	**(2.60)**
Ln (MV)	0.0754 *	0.0555 *	0.1043	0.0678
	(1.80)	(1.83)	(1.52)	(1.44)
R&D/Assets	−0.6443	0.0535	0.3209	−0.7884
	(−0.73)	(0.09)	(0.22)	(−0.70)
Ln (Sales/Emp)	0.1799 **	0.1105 *	0.3564 **	0.2164 **
	(2.25)	(1.91)	(2.54)	(2.26)
CAPX/Assets	−0.6700	−0.7158 ***	−1.3183 **	−0.8914 *
	(−1.61)	(−2.69)	(−2.00)	(−1.96)
PPENT/Assets	1.7622 ***	1.0219 ***	2.9124 ***	1.7357 ***
	(6.39)	(5.22)	(6.44)	(5.69)
ROA	−1.1101 ***	−0.6686 ***	−1.8882 ***	−1.3560 ***
	(−4.32)	(−3.94)	(−4.41)	(−4.70)
Debt/Assets	−0.0105	−0.0103	0.0633	−0.0357
	(−0.06)	(−0.09)	(0.21)	(−0.19)
Cash/Assets	0.1139	−0.0622	−0.0599	0.1029
	(0.63)	(−0.51)	(−0.20)	(0.50)
Q	0.0835 ***	0.0457 **	0.1882 ***	0.1183 ***
	(3.29)	(2.52)	(4.26)	(4.01)
HI	0.5645	0.5545	1.2203	0.6079
	(1.01)	(1.37)	(1.32)	(0.98)
HI^2	−0.5788	−0.5773	−1.3108	−0.6998
	(−1.06)	(−1.45)	(−1.38)	(−1.15)
Ln (Firm Age)	0.5200 ***	0.3842 ***	0.6173 **	0.4246 ***
	(3.77)	(3.67)	(2.50)	(2.68)
Institutional Own.	0.0559	0.0617	0.2527	0.1115
	(0.51)	(0.80)	(1.26)	(0.87)
Insider Ownership	−0.5455	−0.5268 **	−1.0709	−0.7656 **
	(−1.44)	(−2.18)	(−1.63)	(−1.97)
Equity/Total Pay	0.0618	0.0122	0.1675 **	0.0852
	(1.18)	(0.36)	(1.97)	(1.44)
Constant	−3.8820 ***	−2.6636 ***	−6.2006 ***	−3.8054 ***
	(−5.14)	(−4.97)	(−4.88)	(−4.48)
Observations	8607	8607	8607	8607
R-squared	0.334	0.277	0.398	0.286
Firm and Year FE	Yes	Yes	Yes	Yes

While the results in Tables 3 and 4 present clear evidence of the impact that busy directors and interlocked directors have on future innovation, these results do present something of a dilemma. It is possible that board busyness and interlocking directors are separate constructs with separate effects; however, it is perhaps more likely that there are interactions between the two variables. In theory, as a director becomes busier, she is more likely to develop interlocking relationships within the boards on which she serves. To address how these two dynamics interact, we create three new variables: (1) *Busy Non-Interlocked Directors*, (2) *Interlocked Non-Busy Directors* and (3) *Busy and Interlocked Directors*. In Table 5, we present the results from performing the same regressions of innovation on these three new variables.

Table 5. Regressions of Innovation on the Interaction of Director Busyness and Interlocks. This table presents regression results of Innovation on interactions between Director Busyness and Interlocked Directors. Panel A examines Busy Non-Interlocked Directors, defined as the percentage of directors who are busy (on three or more other boards) but not interlocked; Panel B examines Interlocked Non-Busy Directors, defined as the percentage of directors who are not busy but interlocked; Panel C examines Busy and Interlocked Directors, defined as the percentage of directors who are both busy and interlocked. Control variables are omitted for brevity in Panels B and C. All regressions contain firm and year fixed effects. All except binary variables are winsorized at the upper and lower 1% levels. Full variable definitions are provided in the Appendix A. T-statistics are reported in parentheses. Standard errors are adjusted based on the Huber-White sandwich estimate of variances and are clustered by firm. *** indicates significance at the 1% level, ** 5% and * 10%.

Panel A: Busy Non-Interlocked Directors				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Busy Non-Interlocked Directors	**−0.2725 ** **	**−0.2240 *** **	**−0.3842 ** **	**−0.3156 ** **
	(−2.47)	**(−2.95)**	**(−2.27)**	**(−2.58)**
Ln (MV)	0.0782 *	0.0572 *	0.1111	0.0719
	(1.87)	(1.88)	(1.61)	(1.52)
R&D/Assets	−0.6029	0.0834	0.3920	−0.7313
	(−0.68)	(0.14)	(0.27)	(−0.65)
Ln (Sales/Emp)	0.1778 **	0.1084 *	0.3548 **	0.2159 **
	(2.22)	(1.88)	(2.52)	(2.25)
CAPX/Assets	−0.6713	−0.7133 ***	−1.3324 **	−0.8857 *
	(−1.62)	(−2.68)	(−2.02)	(−1.95)
PPENT/Assets	1.7834 ***	1.0395 ***	2.9524 ***	1.7581 ***
	(6.45)	(5.31)	(6.50)	(5.74)
ROA	−1.1057 ***	−0.6636 ***	−1.8866 ***	−1.3548 ***
	(−4.30)	(−3.91)	(−4.41)	(−4.70)
Debt/Assets	−0.0109	−0.0126	0.0665	−0.0326
	(−0.06)	(−0.11)	(0.22)	(−0.17)
Cash/Assets	0.1324	−0.0483	−0.0293	0.1247
	(0.73)	(−0.40)	(−0.10)	(0.60)
Q	0.0825 ***	0.0451 **	0.1858 ***	0.1170 ***
	(3.25)	(2.49)	(4.20)	(3.97)
HI	0.5522	0.5438	1.2155	0.6034
	(0.99)	(1.34)	(1.32)	(0.98)
HI^2	−0.5650	−0.5658	−1.3005	−0.6913
	(−1.05)	(−1.44)	(−1.39)	(−1.15)
Ln (Firm Age)	0.5164 ***	0.3814 ***	0.6159 **	0.4214 ***
	(3.75)	(3.65)	(2.50)	(2.67)
Institutional Own.	0.0492	0.0569	0.2398	0.1027
	(0.45)	(0.73)	(1.19)	(0.80)
Insider Ownership	−0.5268	−0.5099 **	−1.0327	−0.7366 *
	(−1.39)	(−2.13)	(−1.58)	(−1.91)
Equity/Total Pay	0.0589	0.0104	0.1628 *	0.0822
	(1.13)	(0.31)	(1.92)	(1.40)
Constant	−3.8562 ***	−2.6363 ***	−6.2084 ***	−3.7978 ***
	(−5.12)	(−4.95)	(−4.90)	(−4.49)
Observations	8596	8596	8596	8596
R-squared	0.335	0.278	0.399	0.287
Firm and Year FE	Yes	Yes	Yes	Yes
Panel B: Interlocked Non-Busy Directors				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Interlocked Non-Busy Directors	**0.5804 ** **	**0.5532 *** **	**1.2229 *** **	**1.1207 *** **
	(2.08)	**(3.10)**	**(2.75)**	**(3.53)**
Observations	8596	8596	8596	8596
R-squared	0.334	0.277	0.398	0.287
Firm and Year FE	Yes	Yes	Yes	Yes
Panel C: Busy and Interlocked Directors				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Busy and Interlocked Directors	**−0.2565**	**−0.1460**	**−0.4564**	**−0.9982**
	(−0.25)	**(−0.22)**	**(−0.28)**	**(−0.90)**
Observations	8607	8607	8607	8607
R-squared	0.334	0.277	0.397	0.286
Firm and Year FE	Yes	Yes	Yes	Yes

In Panel A, we see that the results for *Busy Non-Interlocked Directors* are similar to—and stronger than—the results in Table 3 using the primary measures for Busy Directors. Thus, the *Busy Director* effect is not being driven by *Interlocked Directors; Busy Directors* generate less innovation. In Panel B, we see that the results for *Interlocked Non-Busy Directors* are

much stronger than those observed in Table 4 for the baseline *Interlocked Directors* analysis. *Interlocked Directors* who are not busy are better able to focus, provide effective advice and share knowledge without their attention being diluted due to other board service. This further supports the theory behind Hypothesis 2a that interlocked directors can be very effective advisors under the appropriate circumstances.

Finally, we focus on only those directors who are both *Busy* and *Interlocked* as the primary explanatory variable. Importantly, we note that all of the effects go away; the costs of directors being busy cancel out the benefits of directors having beneficial interlocking relationships on other boards. Across all measures of innovation, the *Busy* and *Interlocked Directors* variable is insignificant. This result provides novel evidence of how critical director activities and relationships are towards generating value for the firms and boards on which they serve. Not all boards, directors and relationships are the same; it is imperative to understand who the directors are and what relationships they have that can provide value.

4.4. Entrenchment and Innovation

Some impressive literature has studied the relationship between innovation and board entrenchment, both theoretically and empirically; Sapra et al. (2014) and Chemmanur and Tian (2018) find a positive relationship between anti-takeover provisions and patents and citations. As anti-takeover provisions protect managers and directors from takeover threats, they can allow managers to focus on the long-term and to execute expensive and risky strategies, or they can insulate managers from market discipline, thereby leading to ineffective corporate governance and entrenched managers. This literature finds that anti-takeover provisions are associated with more innovation, supporting the theory that they protect managers from market pressure and allow them to focus on long-term strategies.

In Table 6, we analyze the relationship between innovation and director entrenchment. Overall, we consider six different measures of director entrenchment. In Panel A, we present highly significant results that firms with longer-tenured directors generate more patents and more citations. As shown in Table 1, the median tenure for directors in our sample is 10 years; 22% of the directors have board tenures longer than 15 years and 21% of directors have tenures less than five years. Thus, we create two new variables to determine if the general results of Innovation on *Director Tenure* are driven by either extreme. The results are in Table 6, Panels B and C. Directors with tenure of more than 15 years are associated with significantly more innovation, although this result is weaker than the overall measure of *Director Tenure.* Directors with board tenure of less than five years are negatively, but insignificantly, associated with innovation. The results from Table 6, Panels A, B and C support the theory that director entrenchment is beneficial for innovation. This dynamic could be driven by these directors having more firm-specific knowledge, by them having fewer long-term career concerns or by them having more option-value from risky investments due to having accumulated more stockholdings (we study the director ownership dynamic in Section 4.7).

In Panels D and E, we turn to anti-takeover provisions as our measure of entrenchment. In Panel D, we show that the Bebchuk et al. (2009) *E-Index* is significantly positively associated with all four measures of innovation. In Panel E, we show that the Gompers et al. (2003) *G-Index* is significantly associated with more future patents but not with more future citations (the relationship is positive, but statistically insignificant). These findings are generally consistent with the prior literature that more anti-takeover provisions provide managers and directors with the protection to invest in long-term, but risky, projects. Recall that higher *E-Index* and *G-Index* scores are generally associated with worse corporate governance and lower firm value.

Table 6. Regressions of Innovation on Director Entrenchment. This table presents regression results of Innovation on various measures of Director Entrenchment. Panel A examines Director Tenure, defined as the average tenure, on the board, of directors; Panel B examines Tenure >15 Yrs, defined as the percentage of directors with a tenure on the board of 15 years or more; Panel C examines Tenure < 5 Yrs, defined as the percentage of directors with a tenure on the board of less than 5 years; Panel D examines BCF E-Index, defined as the sum of six anti-takeover provisions as in Bebchuk et al. (2009); Panel E examines GIM G-Index, defined as the anti-takeover index from Gompers et al. (2003); and Panel F examines CEO-Chair Duality, an indicator variable that equals one if the firm has a dual CEO-Chair position, zero otherwise. Control variables are omitted for brevity in Panels B, C, D, E and F. All regressions contain firm and year fixed effects. All except binary variables are winsorized at the upper and lower 1% levels. Full variable definitions are provided in the Appendix A. T-statistics are reported in parentheses. Standard errors are adjusted based on the Huber-White sandwich estimate of variances and are clustered by firm. *** indicates significance at the 1% level, ** 5% and * 10%.

Panel A: Director Tenure				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Director Tenure	**0.0116 *** **	**0.0078 *** **	**0.0166 *** **	**0.0144 *** **
	(3.18)	**(3.18)**	**(2.85)**	**(3.43)**
Ln (MV)	0.0759 *	0.0557 *	0.1078	0.0691
	(1.81)	(1.82)	(1.56)	(1.46)
R&D/Assets	−0.6534	0.0459	0.3201	−0.7921
	(−0.74)	(0.08)	(0.22)	(−0.70)
Ln (Sales/Emp)	0.1817 **	0.1114 *	0.3603 **	0.2205 **
	(2.27)	(1.92)	(2.55)	(2.29)
CAPX/Assets	−0.6146	−0.6765 **	−1.2508 *	−0.8147 *
	(−1.48)	(−2.54)	(−1.90)	(−1.79)
PPENT/Assets	1.7529 ***	1.0171 ***	2.9091 ***	1.7215 ***
	(6.33)	(5.17)	(6.40)	(5.62)
ROA	−1.1205 ***	−0.6750 ***	−1.9076 ***	−1.3723 ***
	(−4.36)	(−3.97)	(−4.46)	(−4.76)
Debt/Assets	−0.0109	−0.0120	0.0664	−0.0330
	(−0.06)	(−0.10)	(0.22)	(−0.17)
Cash/Assets	0.1098	−0.0661	−0.0612	0.0981
	(0.60)	(−0.54)	(−0.20)	(0.47)
Q	0.0832 ***	0.0455 **	0.1867 ***	0.1178 ***
	(3.29)	(2.51)	(4.24)	(4.01)
HI	0.5643	0.5544	1.2323	0.6170
	(1.01)	(1.37)	(1.34)	(1.00)
HI^2	−0.5818	−0.5795	−1.3240	−0.7107
	(−1.08)	(−1.47)	(−1.41)	(−1.18)
Ln (Firm Age)	0.5342 ***	0.3943 ***	0.6413 ***	0.4430 ***
	(3.86)	(3.74)	(2.59)	(2.78)
Institutional Own.	0.0555	0.0619	0.2488	0.1102
	(0.51)	(0.80)	(1.24)	(0.86)
Insider Ownership	−0.5248	−0.5137 **	−1.0291	−0.7314 *
	(−1.41)	(−2.17)	(−1.59)	(−1.93)
Equity/Total Pay	0.0623	0.0128	0.1676 **	0.0863
	(1.20)	(0.38)	(1.98)	(1.47)
Constant	−4.0564 ***	−2.7801 ***	−6.4941 ***	−4.0409 ***
	(−5.35)	(−5.16)	(−5.08)	(−4.73)
Observations	8596	8596	8596	8596
R-squared	0.336	0.278	0.399	0.288
Firm and Year FE	Yes	Yes	Yes	Yes
Panel B: Tenure > 15 Yrs				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Tenure > 15 Yrs	**0.1382 ** **	**0.0899 ** **	**0.1631**	**0.1580 ** **
	(2.17)	**(2.15)**	**(1.60)**	**(2.16)**
Observations	8596	8596	8596	8596
R-squared	0.335	0.277	0.398	0.287
Firm and Year FE	Yes	Yes	Yes	Yes

Table 6. *Cont.*

Panel C: Tenure < 5 Yrs				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Tenure < 5 Yrs	**−0.0706**	**−0.0547**	**−0.0956**	**−0.1057**
	(−1.05)	**(−1.23)**	**(−0.90)**	**(−1.37)**
Observations	8596	8596	8596	8596
R-squared	0.334	0.277	0.398	0.286
Firm and Year FE	Yes	Yes	Yes	Yes
Panel D: BCF E-Index				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
BCF E-Index	**0.0774 ***	**0.0641 ***	**0.1408 ***	**0.0863 ***
	(1.81)	**(1.95)**	**(1.85)**	**(1.70)**
Observations	11,416	11,416	11,416	11,416
R-squared	0.321	0.260	0.366	0.268
Firm and Year FE	Yes	Yes	Yes	Yes
Panel E: GIM G-Index				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
GIM G-Index	**0.0345 ***	**0.0301 ***	**0.0581**	**0.0299**
	(1.78)	**(1.93)**	**(1.61)**	**(1.26)**
Observations	11,416	11,416	11,416	11,416
R-squared	0.321	0.260	0.366	0.267
Firm and Year FE	Yes	Yes	Yes	Yes
Panel F: CEO-Chair Duality				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
CEO-Chair Duality	**0.0237**	**0.0207**	**0.0361**	**0.0417 ***
	(1.23)	**(1.53)**	**(1.23)**	**(1.90)**
Observations	8607	8607	8607	8607
R-squared	0.334	0.277	0.397	0.286
Firm and Year FE	Yes	Yes	Yes	Yes

In Panel F, we consider *CEO-Chair Duality*, or whether the CEO of the sample firm also serves as the Board Chair, as our final measure of entrenchment. The results show that *Duality* is positively and significantly related to future, bias-adjusted citations, but insignificantly related to the other 3 measures of innovation.

Altogether, the results presented in Table 6 support Hypothesis 3a that greater director entrenchment is associated with greater corporate innovation; being entrenched protects directors from short-term pressures and allow them to focus on executing long-term strategies, thus leading to more firm innovation through patents and patent citations. This finding, which extends the prior literature, is important because it highlights the nuanced nature of measuring corporate governance constructs. In general, the prior literature has found that director and manager entrenchment is associated with lower firm value. However, our findings show entrenchment is not all bad. Thus, again, it is critical to focus on the specific director characteristics and firm dynamics to better understand these nuanced relationships within corporate governance structures.

4.5. Director Experience and Innovation

We next focus on director-specific characteristics, including their professional experience and expertise and how they influence a firm's innovation strategy. The results of these analyses are presented in Table 7. In Panel A, we consider the percentage of directors who are current CEOs of other firms; Table 1 shows that about 9% of our directors are CEOs at other firms. The results in Table 7 show a negative and highly significant relationship between *CEO of Other Firm* and *Innovation*. Perhaps this result is because CEO-directors have too much responsibility with their employer firm and are unable to focus adequately, or perhaps it is because CEO-directors are too high-level to appropriately advise on the benefits of investments in innovation. In Table 7, Panel B we also show a negative and highly significant relationship between *Chair of Other Firm* and Innovation; this result is not

surprising given the naturally high correlations between *CEO of Other Firm* and *Chair of Other Firm*. The findings in Panels A and B support Hypothesis 4a that CEO (and Chair) directors are associated with generating less innovation.

Table 7. Regressions of Innovation on Director Experience. This table presents regression results of Innovation on various measures of Director Experience. Panel A examines CEO of Other Firm, defined as an indicator variable that equals one if the board has any outside directors whose primary job title includes CEO; Panel B examines Chair of Other Firm, defined as an indicator variable that equals one if the board has any outside directors whose primary job title includes Chairman of the Board; Panel C examines Financial Expertise, defined as the percentage of directors who can be classified as a Financial Expert, per Sarbanes–Oxley; and Panel D examines Director Age, defined as the average age of directors on the board. Control variables are omitted for brevity in Panels B, C and D. All regressions contain firm and year fixed effects. All except binary variables are winsorized at the upper and lower 1% levels. Full variable definitions are provided in the Appendix A. T-statistics are reported in parentheses. Standard errors are adjusted based on the Huber–White sandwich estimate of variances and are clustered by firm. *** indicates significance at the 1% level, ** 5% and * 10%.

Panel A: CEO of Other Firm				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
CEO of Other Firm	**−0.4954 *** **	**−0.3668 *** **	**−0.6852 *** **	**−0.5398 *** **
	(−4.49)	**(−4.92)**	**(−4.09)**	**(−4.27)**
Ln (MV)	0.0772 *	0.0568 *	0.1073	0.0703
	(1.86)	(1.88)	(1.57)	(1.50)
R&D/Assets	−0.6592	0.0431	0.3068	−0.7986
	(−0.75)	(0.07)	(0.21)	(−0.71)
Ln (Sales/Emp)	0.1766 **	0.1082 *	0.3524 **	0.2133 **
	(2.22)	(1.88)	(2.52)	(2.24)
CAPX/Assets	−0.6426	−0.6953 ***	−1.2775 *	−0.8588 *
	(−1.55)	(−2.62)	(−1.94)	(−1.89)
PPENT/Assets	1.7346 ***	1.0014 ***	2.8742 ***	1.7056 ***
	(6.30)	(5.13)	(6.36)	(5.60)
ROA	−1.1026 ***	−0.6632 ***	−1.8791 ***	−1.3490 ***
	(−4.34)	(−3.95)	(−4.43)	(−4.73)
Debt/Assets	−0.0130	−0.0119	0.0624	−0.0360
	(−0.07)	(−0.10)	(0.21)	(−0.19)
Cash/Assets	0.1404	−0.0427	−0.0237	0.1314
	(0.78)	(−0.35)	(−0.08)	(0.64)
Q	0.0851 ***	0.0469 ***	0.1903 ***	0.1200 ***
	(3.37)	(2.60)	(4.31)	(4.08)
HI	0.5487	0.5430	1.2006	0.5926
	(0.99)	(1.34)	(1.30)	(0.96)
HI^2	−0.5650	−0.5672	−1.2932	−0.6861
	(−1.05)	(−1.44)	(−1.38)	(−1.14)
Ln (Firm Age)	0.5101 ***	0.3770 ***	0.6043 **	0.4145 ***
	(3.73)	(3.63)	(2.46)	(2.64)
Institutional Own.	0.0509	0.0580	0.2456	0.1059
	(0.47)	(0.75)	(1.23)	(0.83)
Insider Ownership	−0.5072	−0.4984 **	−1.0175	−0.7236 *
	(−1.35)	(−2.09)	(−1.56)	(−1.88)
Equity/Total Pay	0.0666	0.0158	0.1742 **	0.0904
	(1.29)	(0.48)	(2.07)	(1.55)
Constant	−3.8104 ***	−2.6115 ***	−6.1114 ***	−3.7364 ***
	(−5.09)	(−4.92)	(−4.84)	(−4.44)
Observations	8607	8607	8607	8607
R-squared	0.337	0.280	0.399	0.289
Firm and Year FE	Yes	Yes	Yes	Yes
Panel B: Chair of Other Firm				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Chair of Other Firm	**−0.7242 *** **	**−0.5330 *** **	**−0.9923 *** **	**−0.8579 *** **
	(−6.00)	(−6.30)	(−5.38)	(−6.19)
Observations	8607	8607	8607	8607
R-squared	0.339	0.283	0.401	0.292
Firm and Year FE	Yes	Yes	Yes	Yes

Table 7. *Cont.*

Panel C: Financial Expertise				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Financial Expertise	**−0.1367**	**−0.0799**	**−0.1138**	**−0.0901**
	(−0.71)	(−0.64)	(−0.72)	(−0.45)
Observations	2686	2686	2686	2686
R-squared	0.224	0.201	0.150	0.156
Firm and Year FE	Yes	Yes	Yes	Yes
Panel D: Director Age				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Director Age	**0.0040**	**0.0032**	**0.0156**	**0.0051**
	(0.53)	(0.62)	(1.18)	(0.59)
Observations	8607	8607	8607	8607
R-squared	0.334	0.277	0.398	0.286
Firm and Year FE	Yes	Yes	Yes	Yes

We next address Hypothesis 4b on the relationship between directors who are financial experts and firm innovation. The results show a negative, but insignificant, relationship between *Financial Expertise* and *Innovation*. While these results do not support Hypothesis 4b that *Financial Expertise* will be associated with less firm innovation, it is consistent with Güner et al. (2005) in that finance experts are not associated with more value-creating investments.

Finally, we address Hypothesis 4c, which predicts that younger directors are associated with more firm innovation. The results in Table 7, Panel C show a positive, but insignificant, relationship between *Director Age* and *Innovation*. Thus, the results do not support Hypothesis 4c. As we saw earlier, *Director Tenure* is positively and significantly associated with innovation; it seems plausible that younger directors do exhibit the same career-enhancing desires demonstrated in Kim (2013) and Jenter and Lewellen (2015), but that these goals are not reflected in how they influence a firm's innovation strategy due to their lack of firm-specific experience on the board. Thus, while younger directors may view their service as a real option on their future career, investing in innovation may be too much of a long-term and risky construct to influence the behavior of young directors in the short-term.

4.6. Board Structure and Innovation

Director independence is one of the most researched corporate governance dynamics, with most of the findings suggesting that director independence is associated with better firm performance. The results in Table 8 show no relationship between *Board Independence* and *Innovation*. This finding is important given the past 20 years of regulatory emphasis—SOX, Dodd–Frank, exchange listing requirements—on board independence being associated with better corporate governance. In untabulated results, we also find that neither the percentage of employee directors nor the percentage of affiliated directors is associated with firm innovation. Thus, we do not find evidence to support Hypothesis 5—Board Independence does not seem to impact firm innovation.

4.7. Director Ownership and Innovation

In our final set of analyses, we focus on *Director Ownership* as a measure of corporate governance and incentive alignment. To the extent that innovation is a long-term investment, director stock ownership should incentivize directors to focus on implementing strategies and investments to maximize firm value over the long-term. In Table 9, we consider three different measures of Director Ownership. In Panel A, we present the results using the *Percentage Stock Owned by the Median Director* as the measure of *Director Ownership*; while *% Median Ownership* is positively related to all four measures of innovation, it is only significantly related to *Ln(1 + Pats).*

Table 8. Regressions of Innovation on Board Structure. This table presents regression results of Innovation on Board Independence, defined as the percentage of directors who are independent. All except binary variables are winsorized at the upper and lower 1% levels. Full variable definitions are provided in the Appendix A. T-statistics are reported in parentheses. Standard errors are adjusted based on the Huber–White sandwich estimate of variances and are clustered by firm. *** indicates significance at the 1% level, ** 5% and * 10%.

	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Board Independence	**−0.0331**	**−0.0143**	**0.0123**	**0.0014**
	(−0.69)	**(−0.44)**	**(0.16)**	**(0.02)**
Ln (MV)	0.0765 *	0.0563 *	0.1064	0.0695
	(1.83)	(1.86)	(1.55)	(1.47)
R&D/Assets	−0.6321	0.0643	0.3507	−0.7649
	(−0.71)	(0.11)	(0.24)	(−0.68)
Ln (Sales/Emp)	0.1807 **	0.1113 *	0.3589 **	0.2184 **
	(2.26)	(1.93)	(2.55)	(2.28)
CAPX/Assets	−0.6596	−0.7088 ***	−1.3062 **	−0.8807 *
	(−1.59)	(−2.66)	(−1.98)	(−1.93)
PPENT/Assets	1.7607 ***	1.0213 ***	2.9132 ***	1.7360 ***
	(6.39)	(5.22)	(6.43)	(5.68)
ROA	−1.1117 ***	−0.6704 ***	−1.8943 ***	−1.3606 ***
	(−4.32)	(−3.94)	(−4.42)	(−4.71)
Debt/Assets	−0.0031	−0.0049	0.0742	−0.0265
	(−0.02)	(−0.04)	(0.25)	(−0.14)
Cash/Assets	0.1132	−0.0629	−0.0615	0.1016
	(0.62)	(−0.52)	(−0.21)	(0.49)
Q	0.0833 ***	0.0456 **	0.1876 ***	0.1179 ***
	(3.29)	(2.51)	(4.25)	(4.00)
HI	0.5696	0.5585	1.2295	0.6154
	(1.02)	(1.38)	(1.33)	(0.99)
HI^2	−0.5833	−0.5805	−1.3165	−0.7048
	(−1.07)	(−1.46)	(−1.39)	(−1.16)
Ln (Firm Age)	0.5226 ***	0.3859 ***	0.6198 **	0.4269 ***
	(3.79)	(3.68)	(2.51)	(2.70)
Institutional Own.	0.0547	0.0611	0.2526	0.1112
	(0.50)	(0.79)	(1.26)	(0.87)
Insider Ownership	−0.5453	−0.5265 **	−1.0695	−0.7646 **
	(−1.44)	(−2.18)	(−1.63)	(−1.97)
Equity/Total Pay	0.0614	0.0120	0.1676 **	0.0851
	(1.18)	(0.36)	(1.97)	(1.44)
Constant	−3.8807 ***	−2.6712 ***	−6.2524 ***	−3.8412 ***
	(−5.15)	(−4.99)	(−4.92)	(−4.53)
Observations	8607	8607	8607	8607
R-squared	0.334	0.277	0.397	0.286
Firm and Year FE	Yes	Yes	Yes	Yes

In Panel B, we use the *Median Dollar Value of Director Ownership* as our measure of Director Ownership. As shown in Table 1, the average median USD value of stock owned by directors is approximately USD 2,000,000; for most directors, this amount of ownership should be substantial enough to incentivize them to proactively invest in strategies that will maximize the long-term value of the firm. The results in Table 9, Panel B, show a positive, but statistically insignificant, relationship between the *Dollar Value of Director Ownership* and *Innovation*. While director ownership may be associated with better incentive alignment and corporate governance overall (such as director independence), it may be too much of a macro-level governance construct to significantly capture the specific benefits of investing in innovation.

Finally, we consider the number of directors who do not own any stock as our measure of *Director Ownership*. Table 1 shows that 5% of the directors in our sample do not own any stock in their firms. In theory, these directors do not have any incentive to focus on and invest in the long-term value creation of their firms. Thus, we would expect a negative relationship between % *Shares Zero* and *Innovation*. The results show small and insignificant relationships between % *Shares Zero* and both patents and citations. Overall, our results do not support the prediction in Hypothesis 6 that greater Director Ownership should lead to more firm-level innovation.

Table 9. Regressions of Innovation on Director Ownership. This table presents regression results of Innovation on various measures of Director Ownership. Panel A examines %Median Ownership, defined as the percentage ownership of the median director; Panel B examines Ln (Median Dollar), defined as the natural logarithm of the median dollar value of director ownership; Panel C examines Ln (Median Shares), defined as the natural logarithm of the median number of shares owned by directors; and Panel D examines %Shares Zero, defined as the percentage of directors on the board that owns zero shares. All except binary variables are winsorized at the upper and lower 1% levels. Full variable definitions are provided in the Appendix A. T-statistics are reported in parentheses. Standard errors are adjusted based on the Huber–White sandwich estimate of variances and are clustered by firm. *** indicates significance at the 1% level, ** 5% and * 10%.

Panel A: %Median Ownership				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
%Median Ownership	**0.6119 ***	**0.3869**	**0.6885**	**0.3416**
	(1.70)	**(1.54)**	**(1.15)**	**(0.85)**
Ln (MV)	0.0756 *	0.0556 *	0.1057	0.0692
	(1.81)	(1.83)	(1.54)	(1.47)
R&D/Assets	−0.6350	0.0608	0.3462	−0.7665
	(−0.72)	(0.10)	(0.23)	(−0.68)
Ln (Sales/Emp)	0.1802 **	0.1108 *	0.3586 **	0.2183 **
	(2.25)	(1.92)	(2.55)	(2.28)
CAPX/Assets	−0.6695	−0.7142 ***	−1.3137 **	−0.8846 *
	(−1.61)	(−2.68)	(−1.99)	(−1.94)
PPENT/Assets	1.7650 ***	1.0245 ***	2.9150 ***	1.7373 ***
	(6.40)	(5.23)	(6.44)	(5.68)
ROA	−1.1076 ***	−0.6666 ***	−1.8882 ***	−1.3577 ***
	(−4.31)	(−3.92)	(−4.41)	(−4.71)
Debt/Assets	−0.0074	−0.0082	0.0729	−0.0273
	(−0.04)	(−0.07)	(0.25)	(−0.14)
Cash/Assets	0.1138	−0.0624	−0.0616	0.1015
	(0.63)	(−0.51)	(−0.21)	(0.49)
Q	0.0838 ***	0.0460 **	0.1883 ***	0.1182 ***
	(3.31)	(2.54)	(4.27)	(4.01)
HI	0.5687	0.5580	1.2368	0.6196
	(1.02)	(1.37)	(1.33)	(1.00)
HI^2	−0.5819	−0.5798	−1.3225	−0.7080
	(−1.07)	(−1.46)	(−1.40)	(−1.16)
Ln (Firm Age)	0.5254 ***	0.3879 ***	0.6236 **	0.4287 ***
	(3.82)	(3.71)	(2.53)	(2.71)
Institutional Own.	0.0584	0.0631	0.2538	0.1118
	(0.54)	(0.82)	(1.27)	(0.88)
Insider Ownership	−0.5415	−0.5242 **	−1.0625	−0.7609 **
	(−1.44)	(−2.19)	(−1.62)	(−1.97)
Equity/Total Pay	0.0624	0.0127	0.1688 **	0.0858
	(1.19)	(0.38)	(1.98)	(1.45)
Constant	−3.9132 ***	−2.6852 ***	−6.2581 ***	−3.8480 ***
	(−5.20)	(−5.03)	(−4.93)	(−4.54)
Observations	8604	8604	8604	8604
R-squared	0.334	0.277	0.397	0.286
Firm and Year FE	Yes	Yes	Yes	Yes
Panel B: Ln (Median Dollar)				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Ln (Median Dollar)	**0.0044**	**0.0037**	**0.0078**	**0.0036**
	(1.31)	**(1.56)**	**(1.47)**	**(1.00)**
Observations	8601	8601	8601	8601
R-squared	0.334	0.277	0.397	0.286
Firm and Year FE	Yes	Yes	Yes	Yes
Panel C: %Shares Zero				
	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
%Shares Zero	**−0.0506**	**−0.0187**	**0.0865**	**−0.0056**
	(−0.45)	**(−0.25)**	**(0.56)**	**(−0.05)**
Observations	8604	8604	8604	8604
R-squared	0.334	0.277	0.397	0.286
Firm and Year FE	Yes	Yes	Yes	Yes

4.8. Horse Race: What Matters in Corporate Governance and Innovation?

In the previous sections, we have primarily focused on examining individual corporate governance measures one at a time. In so doing, we are able to reveal their individual relation to innovation without concerns over the multicollinearity or interactions between various governance variables. Nevertheless, it does beg the question regarding which governance measures matter the most when it comes to innovation output, which motivates the horse race analyses in this section.[1]

Our horse race results are presented in Table 10. We run the regressions of innovation measures on various corporate governance metrics altogether, including director busyness, director interlocks, director entrenchment, director experience, board structure and director ownership. For each governance category, we attempt to include the most significant variable if any, as shown in the regression analyses in Tables 3–9, whereas results are quantitatively similar if we include multiple variables for each governance category. Note that for *Director Experience*, we include *CEO of Other Firm* and *Chair of Other Firm* since both variables are highly significant as evidenced in the previous regressions on individual governance variables. Results remain unchanged if we include either one of them in the regressions.

Table 10. Horse Race: Regressions of Innovation on All Corporate Governance Variables. This table presents regression results of Innovation on various measures of corporate governance variables examined in the previous tables, including Director Busyness, Director Interlocks, Director Entrenchment, Director Experience, Board Structure and Director Ownership. Control variables are included in the analyses but not tabulated for conciseness. All regressions contain firm and year fixed effects. All except binary variables are winsorized at the upper and lower 1% levels. Full variable definitions are provided in the Appendix A. T-statistics are reported in parentheses. Standard errors are adjusted based on the Huber–White sandwich estimate of variances and are clustered by firm. *** indicates significance at the 1% level, ** 5% and * 10%.

	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Busy Non-Interlocked Directors	−0.1938 *	−0.1652 **	−0.2785	−0.2179 *
	(−1.73)	(−2.16)	(−1.62)	(−1.76)
Interlocked Non-Busy Directors	0.4857 *	0.4810 ***	1.0936 **	1.0091 ***
	(1.73)	(2.67)	(2.44)	(3.17)
Director Tenure	0.0068 **	0.0044 **	0.0088 **	0.0083 **
	(2.45)	(2.36)	(1.97)	(2.55)
CEO of Other Firm	−0.1688	−0.1233 *	−0.2317	−0.1180
	(−1.48)	(−1.68)	(−1.36)	(−0.92)
Chair of Other Firm	−0.4802 ***	−0.3580 ***	−0.6063 ***	−0.6224 ***
	(−3.95)	(−4.42)	(−3.19)	(−4.53)
Board Independence	−0.0306	−0.0125	0.0177	0.0017
	(−0.63)	(−0.38)	(0.23)	(0.03)
%Median Ownership	0.6009 *	0.3858	0.6398	0.3420
	(1.67)	(1.54)	(1.07)	(0.86)
All other control variables are included but not presented for conciseness				
Constant	−3.8424 ***	−2.6187 ***	−6.2216 ***	−3.7994 ***
	(−5.13)	(−4.93)	(−4.91)	(−4.50)
Observations	8586	8586	8586	8586
R-squared	0.341	0.285	0.402	0.294
Firm and Year FE	Yes	Yes	Yes	Yes

For brevity, the results in Table 10 only include the key governance explanatory variables and not all control variables; the full regression framework is identical to our previous analyses and results are available upon request. Corroborating our findings in the previous regressions on individual governance variables, we find that innovation is significantly and negatively related to *Director Busyness* and *Director Experience* (*Chair of Other Firm*) and positively related to *Director Interlocks* and *Entrenchment*. Again, *Board Independence* and *Director Ownership* do not appear to matter significantly for innovation.

4.9. The Interaction Channel

In light of our findings, not all corporate governance measures are created equal when it comes to innovation. In particular, we find that *Director Busyness* and director experience as the *Chair of Other Firm* are detrimental to innovation, while *Director Interlocks* and *Director Entrenchment* are beneficial. To the extent that these four aspects of corporate governance might be correlated with each other, in this section we perform regression analyses to understand if director busyness, interlocks and experience impact innovation through entrenchment or vice versa.[2]

Table 11 presents the regression results. Essentially we run the regressions of innovation measures on all governance categories and control variables, similar to Table 10 regressions, except that we add three interactive terms, one between director busyness and entrenchment (*Busy Non-Interlocked Directors* × *Director Tenure*), one between director interlocks and entrenchment (*Interlocked Non-Busy Directors* × *Director Tenure*) and one between director experience and entrenchment (*Chair of Other Firm* × *Director Tenure*) to capture the interaction of entrenchment with director busyness, director interlocks and director experience in affecting innovation.[3] Table 11 shows that while both the effects of *Director Busyness* and *Interlocks* on innovation attenuate when we add the respective interactive terms with entrenchment, neither of their interactions are significant in driving innovation output. These results suggest that *Director Busyness* and Interlocks do not appear to affect innovation via entrenchment, or vice versa.

Table 11. Regressions of Innovation on the Interactions of Director Busyness and Interlocks with Entrenchment. This table presents regression results of Innovation on the interaction between Director Busyness and Entrenchment and the interaction between Director Interlocks and Entrenchment. Control variables are included in the analyses but not tabulated for conciseness. All regressions contain firm and year fixed effects. All except binary variables are winsorized at the upper and lower 1% levels. Full variable definitions are provided in the Appendix A. T-statistics are reported in parentheses. Standard errors are adjusted based on the Huber–White sandwich estimate of variances and are clustered by firm. *** indicates significance at the 1% level, ** 5% and * 10%.

	Ln (1 + Pats)	Ln (1 + $Pats_{TN}$)	Ln (1 + Cites)	Ln (1 + $Cites_{TN}$)
Busy Non-Interlocked Directors	−0.0401	−0.1142	−0.0467	−0.1195
	(−0.15)	(−0.61)	(−0.11)	(−0.39)
Interlocked Non-Busy Directors	2.2596 **	1.0904 *	2.1874	1.8785 *
	(2.43)	(1.70)	(1.28)	(1.77)
Director Tenure	0.0047	0.0021	0.0047	0.0047
	(1.34)	(0.90)	(0.86)	(1.15)
Chair of Other Firm	−1.2281 ***	−0.9010 ***	−1.7555 ***	−1.4194 ***
	(−4.23)	(−4.45)	(−3.48)	(−4.16)
Busy Non-Interlocked Directors	−0.0155	−0.0054	−0.0234	−0.0103
× Director Tenure	(−0.73)	(−0.36)	(−0.68)	(−0.41)
Interlocked Non-Busy Directors	−0.1612 *	−0.0552	−0.0994	−0.0790
× Director Tenure	(−1.93)	(−1.00)	(−0.70)	(−0.83)
Chair of Other Firm	0.0606 ***	0.0439 ***	0.0947 **	0.0680 **
× Director Tenure	(2.65)	(2.87)	(2.17)	(2.51)
Board Independence	−0.0320	−0.0141	0.0143	−0.0001
	(−0.66)	(−0.43)	(0.19)	(−0.00)
%Median Ownership	0.6031 *	0.3858	0.6398	0.3416
	(1.69)	(1.54)	(1.08)	(0.86)
All other control variables are included but not presented for conciseness				
Constant	−3.7968 ***	−2.5827 ***	−6.1478 ***	−3.7363 ***
	(−5.06)	(−4.87)	(−4.84)	(−4.43)
Observations	8586	8586	8586	8586
R-squared	0.341	0.286	0.403	0.294
Firm and Year FE	Yes	Yes	Yes	Yes

Interestingly, the interactive term *Chair of Other Firm* × *Director Tenure* is positive and significant, while *Chair of Other Firm* remains highly significant and increases considerably in the magnitude and Director Tenure at the meanwhile loses all significance. This finding

lends some confidence to the conjecture that while serving as the *Chair of Other Firms* may hinder innovation, possibly due to the limited attention being stretched (the same as director busyness), highly entrenched directors are in fact beneficial, probably owing to the exposure to and experience of innovative activities in other firms.

5. Discussion and Limitations

Our analyses in this study include more than 20 measures of corporate governance and several measures of innovation. We have used several different variables for most governance dynamics—such as six different variables to consider director entrenchment. Given the breadth of our analyses, we have made a number of methodological decisions that need to be understood; it is possible that some of these decisions undermine or weaken the results as presented in this study. We discuss these limitations here.

First, as with any study of different corporate governance dynamics and firm characteristics, these variables being simultaneously determined is always a concern. It is possible that innovation determines corporate governance structures and not vice versa, as we assume. If this endogeneity is present, our OLS results might be biased and/or inconsistent.

In all of our studies, as we explain in Section 4, we consider the impact of current corporate governance on future innovation (in $t + 1$); this construction might reduce concerns of simultaneity somewhat. In untabulated results, we have considered longer gaps between governance and innovation (*Year t + 2*, *Year t + 3* and *Year t + 5*) and the results are qualitatively similar to those presented; we have used *Year t + 1* to maximize the size of our sample.

Further, we have not used other econometric methods that have been shown to mitigate endogeneity concerns, such as 2SLS or propensity score matching, because of how many governance variables we consider. Designing appropriate instrumental variables and structure models for the 20+ governance variables we include in this study, might lead to results that are econometrically powerful but not economically meaningful. We were concerned about the cure being worse than the disease; we were concerned about the comparability and consistency across our different analyses. We chose to use OLS for all analyses and to keep our models as parsimonious as possible to better focus on the unique relationship between different corporate governance constructs and corporate innovation. We recognize that this could be a concern with our study. However, we are confident that the associations that we have identified are robust given the power of our sample and the techniques we have employed, even if we cannot conclude causal relationships between certain governance variables and innovation. As such, these associations can still have important policy implications for business leaders, investors, regulators and, of course, other researchers, as they think about how governance dynamics are most likely to enhance and/or impede corporate innovation over both the short-term and the long-term.

Second, we recognize that many of our governance variables might have interactive dynamics between them that we might not have captured. We have, generally, studied one governance variable at a time, hoping to uniquely capture the marginal effects between only that variable and innovation; while this approach is clean, it might be missing certain interactive relationships that we have not captured. In Section 4.9, we have considered the interactive relationship between director busyness and entrenchment; our findings further support for the main results we discussed in prior analyses. It is possible that there are important interaction effects between different governance variables that we have not studied, which could add to the economic story of this study.

Finally, our innovation variables are constructed with the KPSS data; as discussed, we used the KPSS data through to 2010, as most prior studies have done. Since we began this study, the KPSS data have been updated through to 2020; however, we chose to keep the original sample period through 2010 in order to provide the most reliable comparability to other studies, both to prior governance studies and to prior innovation studies. We wanted to make sure that we had a full sample of governance data to pair with our innovation

data; for this, the 2010 data are best. It is possible that some of the dynamics between innovation and governance have changed during the 2010–2020 period, which would not be captured in by our study. During this period, we cannot think of an obvious exogenous event that occurred during this period that might alter this relationship but that does not mean the relationship did not change. Nevertheless, to maximize the usefulness of both our governance and innovation data and to provide the most relevant comparisons to prior work, we felt that using the KPSS data through to 2010 was best.

6. Conclusions

We provide a comprehensive study of how different corporate governance constructs influence innovation. We know that not all corporate governance mechanisms are created equal (Coles et al. 2008); different corporate governance mechanisms can proxy for different incentives in different situations. Our purpose is to disentangle these different constructs and to understand how firms generate innovation. Specifically, we study six different corporate governance constructs: board busyness, interlocked directors, entrenchment, director expertise, board structure and director ownership. We find that busy boards generate less innovation, as do boards with CEOs or Chairs from other companies. Boards with more interlocked directors generate more innovation. When we consider the interaction between busy directors and interlocked directors, the effects of each individual effect go away; busy directors only reduce innovation if they are not also interlocked, while interlocked directors only increase innovation if they are not also busy.

Consistent with other research, we find that entrenched boards are associated with more innovation. Board independence does not significantly affect innovation. Additionally, director ownership is only weakly associated with greater innovation. These findings present something of a puzzle: entrenched boards lead to more innovation but are shown in prior studies to be associated with lower firm value. Similarly, director independence and director ownership have been shown to be associated with higher firm value, but neither seems to enhance long-term innovation uniquely. Also contrary to previous studies and much regulatory policy around the world, we find that the financial expertise of directors is not significantly related with corporate innovation; of course, we appreciate that such regulations have not been designed to increase innovation, but it is important to recognize the many trade-offs inherent in trying to align a corporate governance system with different firm goals.

The seemingly confounding results that we find are likely driven by the fact that innovation is produced over the extreme long-term, while traditional governance studies only consider firm value in the relatively short-term. It is well-established that not all boards are created equally. Different firms have different objectives, operate in different environments and engage different stakeholders. All of these firm-specific differences lead to different needs for the boards of directors and within the corporate governance function of any firm.

We know that R&D intensive firms and firms which rely on innovation to create value need more industry- and firm-specific knowledge on the board of directors (Coles et al. 2008). This presents a need for more employee directors; we show that this need for industry- and firm-specific knowledge extends to the professional relationships of individual board members, as indicated by the benefits of having (non-busy) interlocked directors. We also know that innovation is the result of governance structures that provide the incentives to capitalize on the option value of innovation or provide the incentives to make long-term investments in innovation (Sapra et al. 2014). Our results extend these theories to a more holistic understanding of how the unique aspects of corporate governance dynamics have different implications for different firms in different situations.

We contribute two primary policy implications for firms looking to generate greater innovation. First, boards must be incentivized and empowered to focus on long-term strategies. Second, directors' professional relationships and activities matter. Given that not all corporate governance structures lead to the same outcomes, our findings should

help firms design corporate governance structures that will be better aligned with how they can uniquely create value. Our findings suggest that boards should not be insulated to allow them greater freedom to focus on the long-term. Internal governance choices and structures are what create the unique incentives and dynamics that determine whether the board will have a short-term or long-term perspective (Roe 2013); we provide evidence that the relationships and individual perspectives within a firm's corporate governance system are also significant contributors to that firm's investment strategy.

In addition to those policy implications, we make at least three significant contributions to the corporate governance and innovation literature. First, we provide a comprehensive analysis of how different corporate governance mechanisms influence innovation success. Second, we show how specific director activities produce tradeoffs in the boardroom. As far as we know, this is the first study to examine the effect of board busyness on innovation, and we uncover a negative relationship between busy directors and innovative activities. This finding contributes to both the literature on board busyness and on innovation. Third, we show that certain mechanisms which have previously been shown to be associated with good corporate governance, in general, may not be effective in leading to long-term innovation. Corporate governance is a highly nuanced construct; one size does not fit all, and the different measures of corporate governance may impact different firms in different ways. Further, in practice, corporate governance is a function of human beings and who these humans are is what will determine how corporate governance is affected at each firm. The more we understand the dynamics that take place between directors in the boardroom, the professional experiences of the key individuals in the corporate governance functions and the personal and professional incentives of the key individuals responsible for executing value-creating initiatives, the better firms can structure their corporate governance systems to meet their own specific objectives.

Author Contributions: B.B. and J.Z. contributed equally to the conceptualization, the methodology, the data curation, the econometric analysis, the discussion and the writing. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: All data used in this analysis were obtained and constructed from publicly available sources (KPSS innovation data) and/or privately subscribed databases, including Compustat, CRSP, ExecuComp and ISS.

Acknowledgments: We wish to thank the conference participants at the 2018 Paris Financial Management Conference and the 2018 European Financial Management Association Annual Meeting in Milan, Italy, for their helpful comments. We are also indebted to the Editor and three anonymous referees for their insightful comments and suggestions that have significantly improved this paper. All errors are our own responsibilities.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Variable Definitions

Variable	Definition
Patent Innovation in year t + 1:	
Pats	The total number of patents filed by (and ultimately granted to) a firm in year t + 1 (sample period: application year over 1997–2010).
$Pats_{TN}$	Equals *Pats* divided by the average number of patents filed across all firms in the same application year and the same U.S. Patent and Trademark Office (USPTO) technological class.
Cites	Total future citations received in life on all patents filed by (and ultimately granted to) a firm in year t + 1 (sample period: application year over 1997–2010).
$Cites_{TN}$	Equals *Cites* divided by the total number of citations received on all patents filed in the same USPTO class (HJT technological category) for the same application year.
Ln (1 + Pats)	Natural logarithm of one plus *Pats* in year t + 1.
Ln (1 + $Pats_{TN}$)	Natural logarithm of one plus $Pats_{TN}$ in year t + 1.
Ln (1 + Cites)	Natural logarithm of one plus *Cites* in year t + 1.
Ln (1 + $Cites_{TN}$)	Natural logarithm of one plus *CitesTN* in year t + 1.

Variable	Definition
Board Governance Variables in year t:	
Busy Directors	The percentage of directors who are on three or more other boards (not including the sample firm).
Busy Outside Directors	The percentage of independent directors who are on three or more other boards.
Busy Insider Directors	The percentage of employee directors who are on three or more other boards.
# of Other Boards	The average number of other boards that directors serve on.
Interlocked Directors	The percentage of directors with an interlocking relationship with another board.
Busy Non-Interlocked Directors	The percentage of directors who are busy (on three or more other boards) but not interlocked.
Interlocked Non-Busy Directors	The percentage of directors who are interlocked but not busy.
Busy and Interlocked Directors	The percentage of directors who are both busy and interlocked.
Director Tenure	The average tenure on the board of directors.
Tenure > 15 Yrs	The percentage of directors with a tenure on the board of 15 years or more.
Tenure < 5 Yrs	The percentage of directors with a tenure on the board of less than 5 years.
BCF *E-Index*	The sum of six anti-takeover provisions as in Bebchuk et al. (2009), including staggered board, poison pill, supermajority to approve mergers, limits to amend bylaws, limits to amend charters and golden parachutes.
GIM *G-Index*	The anti-takeover provisions index from Gompers et al. (2003).
CEO-Chair Duality	=1 if the firm has a dual CEO–Chair position, and zero otherwise.
CEO of Other Firm	=1 if the board has any outside directors whose primary job title includes CEO, and zero otherwise.
Chair of Other Firm	=1 if the board has any outside directors whose primary job title includes Chairman of the Board, and zero otherwise.
Financial Expertise	The percentage of directors who can be classified as a Financial Expert, per the Sarbanes–Oxley criteria.
Director Age	The average age of directors on the board.
Board Independence	The percentage of directors who are independent.
%Median Ownership	The percentage ownership of the median director.
Median Dollar	The median dollar value of director ownership.
Median Shares	The median number of shares owned by directors.
%Shares Zero	The percentage of directors on the board that owns zero shares.
Control Variables in year t (with Compustat data items, where applicable)*:*	
Ln (MV)	Natural logarithm of market value of equity [#25*#199].
R&D/Assets	Research and development expenditure over assets [#46/#6].
Ln (Sales/Employee)	Natural logarithm of total sales (#12) scaled by the total number of employees (#39).
CAPX/Assets	Capital expenditure over assets [#128/#6].
PPE/Assets	Net property, plant and equipment to assets [#8/#6].
ROA	Return on assets defined as operating income before depreciation over assets [#13/#6].
Debt/Assets	Book value of debts over book value of total assets [(#34 + #9)/#6].
Cash/Assets	Cash to assets [#1/#6].
Q	Tobin's *q* defined as market value of assets over book value of assets [(#6-#60 + abs(#25*#199))/#6].
HI	Herfindahl index of sales of 4-digit SIC industry where the firm belongs.
HI^2	The square of HI.
Ln (Firm Age)	Natural logarithm of one plus firm age, measured as the number of years listed on CRSP.
Insider Ownership	The percentage of the company's shares owned by top five executives.
Equity/Total Pay	The total value of new restricted stock and stock options granted as a percentage of annual total pay for the top five executives.

Notes

[1] We thank an anonymous referee for raising this important question that leads to our analyses in this section.

[2] We thank an anonymous referee for raising this important question that leads to our analyses in this section.

[3] Note that we include only Chair of Other Firm but exclude CEO of Other Firm from the regression in Table 11 because Table 10 shows that while the former is significant, the latter is not. Results do not change if we include both.

References

Aghion, Philippe, John Van Reenen, and Luigi Zingales. 2013. Innovation and institutional ownership. *American Economic Review* 103: 277–304. [CrossRef]

Ahn, Seoungpil, Pornsit Jiraporn, and Young Sang Kim. 2010. Multiple directorships and acquirer returns. *Journal of Banking and Finance* 34: 2011–26. [CrossRef]

An, Heng, Carl Chen, Qun Wu, and Ting Zhang. 2021. Corporate innovation: Do diverse boards help. *Journal of Financial and Quantitative Analysis* 56: 155–82. [CrossRef]

Asker, John, Joan Farre-Mensa, and Alexander Ljungqvist. 2015. Corporate investment and stock market listing: A puzzle. *Review of Financial Studies* 28: 342–90. [CrossRef]

Atanassov, Julian. 2013. Do hostile takeovers stifle innovation? Evidence from antitakeover legislation and corporate patenting. *Journal of Finance* 68: 1097–131. [CrossRef]
Balsmeier, Benjamin, Lee Fleming, and Gustavo Manso. 2017. Independent boards and innovation. *Journal of Financial Economics* 123: 536–57. [CrossRef]
Bebchuk, Lucian, Alma Cohen, and Allen Ferrell. 2009. What matters in corporate governance. *Review of Financial Studies* 22: 783–827. [CrossRef]
Bebchuk, Lucian, and Alma Cohen. 2005. The costs of entrenched boards. *Journal of Financial Economics* 78: 409–33. [CrossRef]
Belloc, Filippo. 2011. Corporate governance and innovation: A survey. *Journal of Economics Surveys* 26: 835–64. [CrossRef]
Bhagat, Sanjai, and Brian Bolton. 2013. Director ownership, governance and performance. *Journal of Financial and Quantitative Analysis* 48: 105–35. [CrossRef]
Bizjak, John, Michael Lemmon, and Ryan Whitby. 2009. Option backdating and board interlocks. *Review of Financial Studies* 22: 4821–47. [CrossRef]
Bowen, Robert, Shivaram Rajgopal, and Mohan Venkatachalam. 2008. Accounting discretion, corporate governance and firm performance. *Contemporary Accounting Research* 25: 351–405. [CrossRef]
Bushee, Brian. 1998. The influence of institutional investors on myopic R&D investment behavior. *The Accounting Review* 73: 305–53. Available online: https://www.jstor.org/stable/248542 (accessed on 4 September 2022).
Cai, Ye, and Merih Sevilir. 2012. Board connections and M&A transactions. *Journal of Financial Economics* 103: 327–49. [CrossRef]
Cashman, George, Stuart Gillan, and Chulhee Jun. 2012. Going overboard? On busy directors and firm value. *Journal of Banking and Finance* 36: 3248–59. [CrossRef]
Chang, Chin-Hung, and Qingqing Wu. 2020. Board networks and corporate innovation. *Management Science* 67: 3618–54. [CrossRef]
Chang, Xin, Gilles Hilary, Jun-Koo Kang, and Wenrui Zhang. 2015. Innovation, Managerial Myopia, and Financial Reporting. INSEAD Working Paper No. 2013/35/AC. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2189938 (accessed on 4 September 2022).
Chemmanur, Thomas, and Xuan Tian. 2018. Do anti-takeover provisions spur corporate innovation? A regression discontinuity analysis. *Journal of Financial and Quantitative Analysis* 53: 1163–94. [CrossRef]
Chen, Kevin, and Wayne Guay. 2018. Busy directors and shareholder satisfaction. *Journal of Financial and Quantitative Analysis* 55: 2181–210. [CrossRef]
Coles, Jeffrey, Naveen Daniel, and Lalitha Naveen. 2008. Boards: Does one size fit all? *Journal of Financial Economics* 87: 329–56. [CrossRef]
Core, John, Robert Holthausen, and David Larcker. 1999. Corporate governance, chief executive compensation, and firm performance. *Journal of Financial Economics* 51: 371–406. [CrossRef]
DeFond, Mark, Rebecca Hann, and Xuesong Hu. 2005. Does the market value financial expertise on audit committees of boards of directors? *Journal of Accounting Research* 43: 153–93. [CrossRef]
Devos, Erik, Andrew Prevost, and John Puthenpurackal. 2009. Are interlocked directors effective monitors? *Financial Management* 38: 861–87. [CrossRef]
Duchin, Ran, John Matsuaka, and Oguzhan Ozbas. 2010. When are outside directors effective? *Journal of Financial Economics* 96: 195–214. [CrossRef]
Fahlenbrach, Rudiger, Angie Low, and Rene Stulz. 2010. Why do firms appoint CEOs as outside directors? *Journal of Financial Economics* 97: 12–32. [CrossRef]
Falato, Antonio, Dalida Kadyrzhanova, and Ugur Lel. 2014. Distracted directors: Does board busyness hurt shareholder value? *Journal of Financial Economics* 113: 404–26. [CrossRef]
Faleye, Olubummi. 2007. Classified boards, firm value, and managerial entrenchment. *Journal of Financial Economics* 83: 501–29. [CrossRef]
Ferris, Stephen, Murali Jagannathan, and Adam Pritchard. 2003. Too busy to mind the business? Monitoring by directors with multiple board appointments. *Journal of Finance* 58: 1087–112. [CrossRef]
Fich, Eliezer. 2005. Are some outside directors better than others? Evidence from director appointments by Fortune 1000 firms. *Journal of Business* 78: 1943–72. [CrossRef]
Fich, Eliezer, and Anil Shivdasani. 2006. Are busy boards effective monitors? *Journal of Finance* 61: 689–724. [CrossRef]
Fich, Eliezer, and Lawrence White. 2005. Why do CEOs reciprocally sit on each other's boards? *Journal of Corporate Finance* 11: 175–95. [CrossRef]
Field, Laura, Michelle Lowry, and Anahit Mkrtchyan. 2013. Are busy boards detrimental? *Journal of Financial Economics* 109: 63–82. [CrossRef]
Fracassi, Cesare, and Geoffrey Tate. 2012. External networking and internal firm governance. *Journal of Finance* 67: 153–94. [CrossRef]
Gompers, Paul, Joy Ishii, and Andrew Metrick. 2003. Corporate governance and equity prices. *The Quarterly Journal of Economics* 118: 107–56. [CrossRef]
Graham, John, Campbell Harvey, and Shiva Rajgopal. 2005. The economic implications of corporate financial reporting. *Journal of Accounting and Economics* 40: 3–73. [CrossRef]
Güner, Burak, Ulrike Malmendier, and Geoffrey Tate. 2005. Financial expertise of directors. *Journal of Financial Economics* 88: 323–54. [CrossRef]

Hall, Bronwyn. 2005. A note on the bias in Herfindahl-type measures based on count data. *Revue d'Économie Industrielle* 110: 149–56. [CrossRef]
Hall, Bronwyn, Adam Jaffe, and Manuel Trajtenberg. 2002. The NBER patent citations data file: Lessons, insights and methodological tools. In *Patents, Citations, and Innovations: A Window on the Knowledge Economy*. Edited by Adam B. Jaffe and Manuel Trajtenberg. Cambridge: The MIT Press.
Hall, Bronwyn, Adam Jaffe, and Manuel Trajtenberg. 2005. Market value and patent citations. *RAND Journal of Economics* 36: 16–38. Available online: http://www.jstor.org/stable/1593752 (accessed on 4 September 2022).
Hart, Oliver. 1995. Corporate governance: Some theory and implications. *The Economic Journal* 105: 678–89. [CrossRef]
He, Jack, and Xuan Tian. 2013. The dark side of analyst coverage: The case of innovation. *Journal of Financial Economics* 109: 856–78. [CrossRef]
Helmers, Christian, Manasa Patnam, and Raghavendra Rau. 2017. Do board interlocks increase innovation? Evidence from a corporate governance reform in India. *Journal of Banking and Finance* 80: 51–70. [CrossRef]
Hochberg, Yael, Alexander Ljungqvist, and Yang Lu. 2007. Whom you know matters: Venture capital networks and investment performance. *Journal of Finance* 62: 251–301. [CrossRef]
Jensen, Michael, and William Meckling. 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3: 305–60. [CrossRef]
Jenter, Dirk, and Katharina Lewellen. 2015. CEO preferences and acquisitions. *Journal of Finance* 70: 2813–52. [CrossRef]
Jiraporn, Pornsit, Young Kim, and Wallace Davidson. 2008. Multiple directorships and corporate diversification. *Journal of Empirical Finance* 15: 418–35. [CrossRef]
Khan, Mozaffar, and Ross Watts. 2009. Estimation and empirical properties of a firm-year measure of accounting conservatism. *Journal of Accounting and Economics* 48: 132–50. [CrossRef]
Kim, Soojin. 2013. The acquisitiveness of youth: CEO age and acquisition behavior. *Journal of Financial Economics* 108: 250–73. [CrossRef]
Knyazeva, Anzhela, Diana Knyazeva, and Ronald Masulis. 2013. The supply of corporate directors and board independence. *Review of Financial Studies* 26: 1561–605. [CrossRef]
Kogan, Leonid, Dimitris Papanikolaou, Amit Seru, and Noah Stoffman. 2017. Technological innovation, resource allocation, and growth. *The Quarterly Journal of Economics* 132: 665–712. [CrossRef]
Larcker, David, Eric So, and Charles Wang. 2013. Boardroom centrality and firm performance. *Journal of Accounting and Economics* 55: 225–50. [CrossRef]
Manso, Gustavo. 2011. Motivating innovation. *Journal of Finance* 66: 1823–69. [CrossRef]
Mbanyele, William. 2021. Staggered boards, unequal voting rights, poison pills and innovation intensity: New evidence from the Asian markets. *International Review of Law and Economics* 85: 105970. [CrossRef]
Nguyen, Bang, and Kasper Nielsen. 2010. The value of independent directors: Evidence from sudden death. *Journal of Financial Economics* 98: 550–67. [CrossRef]
O'Connor, Matthew, and Matthew Rafferty. 2012. Corporate governance and innovation. *Journal of Financial and Quantitative Analysis* 47: 397–413. [CrossRef]
Roe, Mark. 2013. Corporate short termism—In the boardroom and in the courtroom. *The Business Lawyer* 68: 977–1006. [CrossRef]
Sapra, Haresh, Ajay Subramanian, and Krishnamurthy Subramanian. 2014. Corporate governance and innovation: Theory and evidence. *Journal of Financial and Quantitative Analysis* 49: 957–1003. [CrossRef]
Shleifer, Andrei, and Robert Vishny. 1997. A survey of corporate governance. *Journal of Finance* 52: 737–83. [CrossRef]
Trajtenberg, Manuel, Rebecca Henderson, and Adam Jaffe. 1997. University versus corporate patents: A window on the basicness of invention. *Economics of Innovation and New Technology* 5: 19–50. [CrossRef]
Wang, Ying, and Jing Zhao. 2015. Hedge funds and corporate innovation. *Financial Management* 44: 353–85. [CrossRef]
Zhang, Haofei. 2017. *Product Market Competition and Corporate Governance: Substitutes or Complements? Evidence from CEO Duality*. Working Paper. Toronto: University of Toronto. [CrossRef]