



Innovation capital disclosure and independent directors: evidence from France

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Received: 8 March 2023 / Accepted: 20 March 2024
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Abstract

This study aims to understand whether corporate governance mechanisms affect innovation capital disclosure (ICD) provided voluntarily on corporate websites by SBF 120 listed firms in France. The study tests multivariate models using pooled OLS, random effects, and generalized method of moments models. Firms use ICD as a useful, timely communication tool to highlight their innovation efforts. Our findings suggest that independent non-executive directors (INEDs) exhibit a conservative approach to the nature of innovation that requires extensive investigations with risky outcomes. They support discretion by limiting the extent of publicly disclosed information about research and development (R&D) progress, technological advances, and innovation output to protect the firms' intellectual proprietary. INEDs seem to balance preserving firms' competitive advantage and ensuring higher transparency levels to satisfy stakeholders' needs. Additionally, board tenure moderates the relationship between INEDs and ICD. This study underscores the importance of the financial reporting of information about innovation capital that captures firms' innovation capacities in a knowledge-based economy. It provides significant insights for management, policy-makers, and regulators who are involved in refining corporate reporting policies. This study is the first to examine the incentives of INEDs in influencing reporting practices related to a firm's innovation investments, particularly in high-technology firms.

Keywords Innovation capital disclosure · Online disclosure · Independent directors · Corporate governance · High-technology firms

Introduction

Innovation capital disclosure (ICD) has received increased attention given the crucial role of innovation in a firm's success (Chen et al. 2017; Lakhali and Dedaj 2020). Innovation capital refers to investments in research and development (R&D) that involve skilled human capital and advanced technologies (Gu and Li 2003; Hashim et al. 2015; Xia and Wang 2021). As part of intellectual capital, innovation

capital reflects a firm's ability to generate innovative technological solutions fueled by progress in information technologies and ongoing R&D projects (Bellora and Guenther 2013; Guthrie and Petty 2000). R&D activities play a key role in enhancing a firm's value and growth (Jia 2019; Simpson and Tamayo 2020). Disclosure of voluntary information on key innovation metrics helps stakeholders, such as investors, make informed capital allocation decisions (Hirschey et al. 2001; Gu and Li 2003; Chin et al. 2006; Hamed and Omri 2016; Glaeser et al. 2020). Gu and Li (2003) highlighted the importance of high-technology firms' innovation disclosure in their corporate press releases. In addition, Hamed and Omri (2016) focused on technology disclosure in annual reports. According to Lakhali and Dedaj (2020), the benefits of higher R&D disclosure by French-listed firms include greater visibility in the market and better earnings quality. Although innovation is important, current financial reporting seems opaque because it does not divulge how innovation-oriented activities may generate value for shareholders (Da Silva et al. 2013; Gordon et al. 2020; Hamed and

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Omri 2016), particularly in the context of high-technology industries that rely on R&D investments (Gu and Li 2003).

Independent directors (INEDs) play a key role in monitoring and providing objective advice to safeguard shareholders' interests (Przybyłowski et al. 2011). Rooted in resource-dependence theory (Pfeffer and Salancik 1978), directors fulfill resource-dependence roles to help firms respond to their changing business environment (Hillman et al. 2000). Directors' profiles matter as they are hired for their merits, qualifications, specific experience, and strategic oversight (Fedaseyeu et al. 2018; Hillman et al. 2000; Khatib et al. 2020; Reguera-Alvarada and Bravo, 2017), particularly in firms that are increasingly dependent on innovation. Grounded in agency theory, board independence may mitigate management's opportunistic behavior and alleviate agency conflicts to safeguard stakeholders' interests (Cerbioni and Parbonetti 2007; Fama and Jensen 1983; Goebel 2019). INEDs are involved in resolving agency conflicts between management and stakeholders (Fama and Jensen 1983), thereby leading to enhanced board effectiveness and better accountability (Roberts et al. 2005; Przybyłowski et al. 2011). Boards with diverse skills pertinent to the industry may play a key role in shaping strategic choices (Deutsch 2005), contributing to more effective management of intellectual capital (Mardini and Lahyani 2022), particularly in firms facing intense market competition (Fu 2019). INEDs are shareholder-oriented members who have the potential to maximize firms' performance (Deutsch 2005; Reguera-Alvarada and Bravo, 2017) by supporting higher innovation (Fu 2019). As innovations developed internally are not reported in financial statements, firms tend to use alternative communication channels to respond to growing stakeholders' calls for enhanced transparency and to shed light on the breakthroughs in the firms' innovation (Jia 2019).

Although an increasing interest among academics in intellectual capital topics and innovation, whether INEDs may influence innovation disclosure is still unknown. Previous literature has focused on the role played by board members in shaping disclosure (Yekini et al. 2015), such as intellectual capital disclosure (Nicolò et al., 2020). Empirical studies have provided mixed results because the effect of external directors on intellectual capital disclosure is positive (Vitolla et al. 2020), negative (Kusumawardani et al. 2021; Tejedo-Romero et al. 2017), or insignificant (Hidalgo et al. 2011). There are two streams of research related to the relationship between INEDs and disclosure. The first stream considers that INEDs' presence on the corporate board is associated with higher levels of disclosure. INEDs are less likely to be influenced by management interests and are more likely to prioritize shareholders' interests (Khatib et al. 2020). On the contrary, the second stream of literature has underscored the costs of higher disclosure of innovation information (Glaeser 2018) and documented that

the relationship between INEDs and voluntary disclosure is negative. Indeed, the main motive behind withholding value-relevant innovation information is to preserve a firm's competitive advantage (Gordon et al. 2020; Simpson and Tamayo 2020; Verrecchia 1983).

We referred to prior studies conducted in France to underscore the importance of voluntary disclosure (Assidi 2020; Barros et al. 2013; Depoers, 2000; Lahyani 2022) such as intellectual capital disclosure (Boujelbene and Affes 2013; Mardini and Lahyani 2022) and R&D disclosure (Lakhali and Dedaj 2020) on annual reports or corporate websites (Boubaker et al. 2012; Gajewski and Li 2015). These studies have posited that a board's independence contributes to higher voluntary disclosure (Barros et al. 2013; Lahyani 2022), leading to enhanced firm value and greater stakeholder confidence (Assidi 2020). Boujelbene and Affes (2013) examined whether higher intellectual capital disclosure affects the cost of equity capital. Mardini and Lahyani (2022) documented that in France, external directors encourage higher disclosure of intellectual capital information to stakeholders in CEO statements. However, these studies have overlooked the role of independent members in shaping disclosure policies related to key innovation indicators.

Given the limited evidence on innovation disclosure, the purpose of our research is threefold. First, the study investigates the role of INEDs on the board to determine the extent of voluntary ICD. The existing literature offers little knowledge about the determinants of ICD (Bellora and Guenther 2013; Gordon et al. 2020; Jia 2019). To narrow this gap, our analysis examines motives for voluntary ICD given the importance of innovation for firms' competitiveness and success in France. The choice of the French context is motivated by INEDs' dominance on corporate boards (Lahyani 2022) and the importance of intellectual capital (i.e., innovation) in developed markets, which aim to lead scientific and technological progress in knowledge-based economies (Boujelbene and Affes 2013). Under the French corporate governance system (AFEP-MEDEF code), the share of INEDs should account for at least half of the board members in widely held firms. Based on the Global Innovation Index (2022), France's relatively high rank at the worldwide level (12th position) mirrors the importance of innovation in the country. This is largely due to French national strategies that encourage research activities and innovation culture (Lakhali and Dedaj 2020). Moreover, in 2008, France implemented R&D tax incentives that aim to encourage firms to invest more in R&D projects. Recently, France has adopted important reforms, namely the PACTE in 2019 and the Research Programming Law in 2020, to foster innovation and motivate collaboration between the academic community and industry. The present study seeks to enhance understanding of the characteristics of ICD and incentives, explaining why INEDs tend to support discretion



regarding innovation in the context of a civil-law country that prioritizes stakeholders' needs and supports greater transparency (Ball et al. 2000). Second, our research adds to the innovation disclosure literature by providing empirical evidence on whether INEDs serving in boardrooms within technology-intensive firms, which are recognized for their reliance on innovation, encourage higher transparency. As substantial resources are allocated to R&D projects, particularly in technology-intensive firms, management generally holds important information about R&D projects. This may produce information asymmetries between managers and investors, the latter of whom require relevant information to correctly assess the firm's prospects and value (Gordon et al. 2020). The current study addresses this gap and offers a better understanding of the role played by INEDs appointed in high-technology firms in determining ICD policies. Finally, the study contributes to the literature by investigating the moderating influence of board tenure on the relationship between independent members and the extent of ICD in France. To the best of our knowledge, such an endeavor has not been undertaken previously. INEDs with greater experience may bring knowledge and networks and offer better insights.

Our evidence has implications for managers, stakeholders, policy-makers, and regulators in knowledge-based economies. Our findings suggest that board independence has significant implications for a firm's strategic decisions, particularly in the context of ICD. This study enriches the literature on management incentives to balance between disseminating more online non-mandatory innovation metrics to a wide range of stakeholders, such as investors, and supporting higher discretion to safeguard innovation secrets and maintain the firm's competitive advantage. Long-tenured INEDs can enhance transparency by highlighting the advantages of voluntary disclosure that outweigh disclosure costs (Depoers, 2000; Gu and Li 2003; Simpson and Tamayo 2020), and underscoring the effectiveness of the monitoring (James et al. 2021) of innovation resources (Fu 2019). In technology-intensive firms, INEDs need to consider proprietary costs and the trade-off between stakeholders' pressure to improve transparency levels and shareholders' interests when determining ICD practices under fierce global competition. Our results are relevant for policy-makers who seek to encourage new forms of integrated reporting in the digital era. Recognizing the significance of stakeholders' information needs for appropriate investment decisions, regulators need to promote the online reporting of reliable innovation indicators for better interactive communications with international stakeholders.

The remainder of our empirical study is organized as follows. After the introduction, Sect. "Literature review: theoretical framework and hypothesis development" reviews the prior literature and delineates the research hypotheses.

Sect. "Research methodology" outlines the study methodology and research design, while Sect. "Results" details the empirical results. Finally, Sect. "Conclusion" summarizes the overall findings, main implications, and recommendations for future research.

Literature review: theoretical framework and hypothesis development

Innovation capital disclosure

Innovation capital refers to investments in knowledge-based assets (Hashim et al. 2015). Such investments shape a firm's survival and prosperity (Striukova et al. 2008). Prior literature asserted that with rapid technological development, the concept of innovation capital symbolizes knowledge-oriented resources that aim to create original products with the help of more advanced technologies (Kianto et al. 2017; Xia and Wang 2021). Guthrie and Petty (2000) underscored the importance of information technology, along with R&D efforts, in understanding the concept of innovation capital. The contribution of human capital to generate groundbreaking projects and knowledge-based assets is significant (Kianto et al. 2017).

Prior studies have drawn on agency theory to justify management incentives for disclosing non-mandatory information (Chiu et al. 2021; Fama and Jensen 1983; Sardo et al. 2018; Simpson and Tamayo 2020). Studies on agency theory have documented that demands for higher voluntary innovation disclosures arise from information asymmetry about the long-term and uncertain nature of research activities between management and stakeholders, such as investors (Chin et al. 2006; Goebel 2019; Simpson and Tamayo 2020). Firms are likely to voluntarily disclose information about their innovation efforts in response to stakeholders' demands (Castilla-Polo and Ruiz-Rodríguez 2017) for higher transparency concerning innovation activities (Chin et al. 2006) and the firm's future performance (Chiu et al. 2021) in a competitive market (Fu 2019). Intangible assets, such as patents, strengthen firms' competitiveness (Gordon et al. 2020; Sardo et al. 2018). Considering the strategic significance of information about knowledge-based resources for stakeholders, higher ICD reflects an enhanced transparency level in reporting innovation, particularly in endeavors that necessitate substantial funds to undertake extensive R&D projects (Bellora and Guenther 2013; Gu and Li 2003; Guthrie and Petty 2000). Such information is value-relevant for stakeholders, including investors, as it facilitates a more accurate assessment of the firm's innovation capacities and prospects (Simpson and Tamayo 2020). In this regard, Hirschey et al. (2001) demonstrated the significance of information



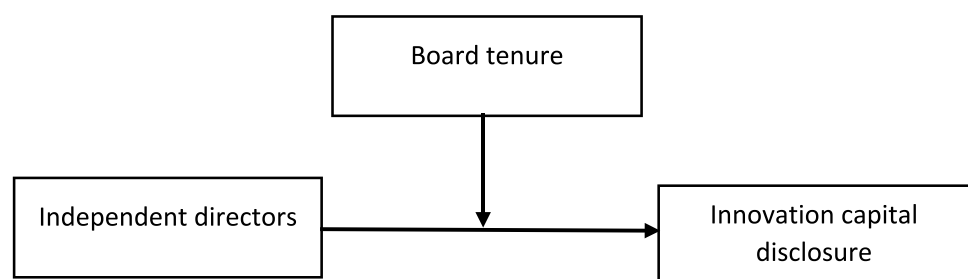
about successful R&D projects in high-technology firms for investors to assess long-term firm valuation. Given the importance of innovation, firms are more likely to use ICD as a strategic communication tool to draw stakeholders' attention to innovation efforts (Glaeser et al. 2020; Gordon et al. 2020; Xia and Wang 2021), predicting higher firm growth (Bellora and Guenther 2013; Jia 2019). Higher disclosure of intellectual capital is likely to promote groundbreaking research projects (Nicolo' et al. 2020) and to counter funding constraints by reducing capital costs (Boujelbene and Affes 2013).

Despite its economic importance, ICD is not mandatory under current accounting standards such as International Accounting Standard 38 on intangible assets. Investment in innovation is generally risky and necessitates comprehensive investigations with delayed payoffs (Simpson and Tamayo 2020). This category of assets is not reported in firms' financial statements because their future economic benefits are uncertain (Chin et al. 2006). Therefore, investors may face difficulties in assessing a firm's value because the reported assets understate the value of innovation investments (Gordon et al. 2020). It is important to understand the motives behind disclosing information beyond the mandatory information in corporate annual reports (Lakhali and Dedaj 2020; Simpson and Tamayo 2020) or any other communication channel, such as corporate websites (Gerpott et al. 2008; Orens et al. 2009; Rossi et al. 2018). With the progress in Internet technology, online disclosure has resulted in a change in the way firms communicate with their stakeholders. Compared with traditional paper-based annual reporting, online disclosure offers the opportunity to disseminate relevant real-time information to a wide array of stakeholders at low cost (Gerpott et al. 2008; Orens et al. 2009; Striukova et al. 2008) while ensuring higher visibility across international audiences (Rossi et al. 2018). Given the growing global competition, prior studies conducted in France have asserted that online disclosure serves as an interactive communication channel that reduces information asymmetry between management and firms' stakeholders (Boubaker et al. 2012), and enhances accessibility to well-structured information (Gajewski and Li 2015).

Innovation capital disclosure and independent directors

This study examines whether INEDs determine the extent of ICD (Fig. 1). Considering their objectivity as external professionals, INEDs play pivotal monitoring and advising roles on behalf of shareholders (Deutsch 2005; Jensen and Meckling 1976), thereby shaping firm performance (Lu et al. 2022). Previous studies have documented that INEDs affect strategic choices (Deutsch 2005; Reguera-Alvarada and Bravo, 2017) such as innovation (Fu 2019) and voluntary disclosure levels (Vitolla et al. 2020; Yekini et al. 2015). Grounded in resource-dependence theory (Hillman et al. 2000; Pfeffer and Salancik 1978), INEDs are resource providers. They are appointed for their expertise, experience, and networks (Hassan and Lahyani 2020; Lu et al. 2022; Reguera-Alvarada and Bravo, 2017). Agency theory advocates suggest that INEDs with varied professional experience are engaged in resolving agency conflicts and ensuring neutrality in the decision-making process for more effective monitoring (Fama and Jensen 1983), and higher transparency levels (James et al. 2021; Yekini et al. 2015). This is partly because of their expertise and impartiality as non-executives. They endeavor to align the interests of management and shareholders by reducing information asymmetries (Guthrie and Parker, 2000). Coherent with agency theory arguments, board independence along with non-mandatory disclosures represent two valuable instruments that have the potential to minimize management opportunistic behavior and reduce information asymmetry (Cerbioni and Parbonetti 2007; Fama and Jensen 1983; Hassan and Lahyani 2020). INEDs excel as effective monitors, particularly when firms require crucial resources to adapt to a dynamic environment (Hillman et al. 2000; Lu et al. 2022), leading to higher board effectiveness and improved decision-making processes (Roberts et al. 2005; Przybyłowski et al. 2011), particularly in relation to knowledge-based resources. Two opposing views can explain INEDs' behavior related to voluntary intellectual capital disclosure. The first research stream posited that outsiders enhance the information environment (James et al. 2021), while the second suggested reporting discretion (Xia and Wong, 2021), recognizing the importance of proprietary costs (Verrecchia 1983). Directors may

Fig. 1 Relationship between INEDs and voluntary ICD



use innovation disclosure as a useful communication tool to reduce agency conflicts (Gajewski and Li 2015), counter difficulties financing substantial investments in R&D activities (Chin et al. 2006), and help differentiate their firms from rivals under fierce global competition (Gordon et al. 2020). James et al. (2021) and Yekini et al. (2015) suggested that INEDs are committed to producing high-quality disclosures for a more transparent environment. Vitolla et al. (2020) documented that INEDs enhance intellectual capital disclosure quality in the context of integrated reporting for higher accountability. Enhanced transparency related to a firm's innovation activities can help build investors' confidence and support sustainable long-term growth (Simpson and Tamayo 2020). Sensitive to the interests of stakeholders, such as investors, board directors may play an effective role in supporting higher transparency levels related to knowledge-based resources. Because of the uncertain nature of R&D projects, stakeholders may find it difficult to foresee the outcomes of innovation efforts (Gordon et al. 2020; Gu and Li 2003). As in-house intangible assets are not reported in annual reports, board members may highlight the firm's innovation breakthroughs and respond to stakeholders' increasing calls for higher transparency (Jia 2019) using alternative communication channels, such as online reporting (Gajewski and Li 2015). INEDs may play a key role in enhancing transparency levels through higher disclosure of innovation capital on corporate websites. As opposed to paper-based financial reporting, online disclosure is a useful communication channel that can be used to change the way firms communicate information to their stakeholders and to ensure the dissemination of real-time information at low cost (Rossi et al. 2018; Striukova et al. 2008). Therefore, we propose the following hypothesis:

H1a: Independent directors positively affect ICD.

A second stream of literature has raised concerns about the usefulness of increased transparency when disclosing information about firms' R&D phases, human capital, and progress in information technology infrastructure that would be useful for the firm's rivals (Glaeser 2018). Previous studies have posited that outsiders are likely to support discretion by communicating less information about a firm's intellectual capital to stakeholders (Kusumawardani et al. 2021; Tejedo-Romero et al. 2017). There are several incentives for INEDs to withhold information about R&D stages, human capital involved in R&D, and technological progress. Investment in R&D requires secrecy, and long investigations with uncertain outcomes (Lakhali and Dedaj 2020). ICD is a strategic decision that includes important implications for the firm's survival (Gordon et al. 2020; Nicolò et al. 2020). Given the strategic importance of innovation activities, INEDs may raise the credibility of voluntarily disclosed narrative information to increase stakeholders' level of satisfaction when relevant extensive disclosure is mainly beneficial

to the firm's competitors. Firm innovation requires appropriate protection of corporate intellectual proprietary (Verrecchia 1983). The full-disclosure strategy related to innovation activities seems to be a risky choice for R&D-oriented firms in the context of aggressive market competition (Jia 2019), while the partial disclosure strategy is more plausible (Simpson and Tamayo 2020). This latter strategy implies revealing a limited volume of information to stakeholders to maximize the firm's future valuation (Castilla-Polo and Ruiz-Rodríguez 2017). The extent of voluntary disclosure is determined by balancing their underlying benefits and costs (Depoers, 2000; Gu and Li 2003). Concerned about their career progress (Hassan and Lahyani 2020), INEDs may encourage partial disclosure of strategic information about innovation to trade off between preserving shareholders' interests and stakeholders' information needs. Xia and Wong (2020) argued that under growing market challenges, firms are more prone to delimit their technological innovation disclosure level to preserve their competitive advantage and ensure better performance.

The present study is motivated by the lack of evidence on the effect of INEDs on ICD despite the growing interest in knowledge-based resources. Considering their merits and valuable contributions to the boardroom, we expect INEDs to encourage limited levels of online disclosure about the firm's innovation capital, a key factor that reinforces the firm's competitive edge. Based on the above arguments, we propose the following hypothesis:

H1b: Independent directors negatively affect ICD.

Innovation capital disclosure and independent directors, the moderating role of board tenure

Several scholars have examined the heterogeneity of INEDs' membership on corporate boards, with a particular focus on their tenure. Reguera-Alvarada and Bravo (2017) suggested that board tenure determines INEDs' effectiveness (Fedaseyeu et al. 2018). Highly qualified and knowledgeable directors determine the board's effectiveness. They may shape the effectiveness of knowledge-based resources and enable better strategic decisions, leading to improved firm performance (Salehi and Zimon 2021). According to James et al. (2021, p. 2), "long-tenured INEDs are better monitors and advisors". This is plausible from a resource-dependence perspective (Hillman et al. 2000; Pfeffer and Salancik 1978), because INEDs equip the board with higher experience, add value to the boardroom. Indeed, a corporate board with longer-tenured directors obtains a deeper understanding and knowledge about the industry over time and can better analyze stakeholders' requirements (Lahyani 2022; Rao and Tilt 2016). However, the effectiveness of the monitoring role of independent board members may be compromised because long-tenured directors are more likely to



build close relationships with the management team over time (James et al. 2021). Moreover, their strategic decisions, such as disclosure practices, tend to be influenced by the firm's management interests when they express their willingness to be reelected in the boardroom.

In line with agency theory advocates (Fama and Jensen 1983), long-tenured directors contribute to decreasing information asymmetries between management and stakeholders. As board tenure captures directors' experience, this strand of the literature has suggested that long board tenure may lead to higher transparency by disseminating a higher volume of voluntary information to stakeholders to restrain management misconduct (James et al. 2021). Rao and Tilt (2016) documented that long-tenured directors are more powerful in stimulating higher disclosures about corporate social responsibility in Australia compared to their short-tenured counterparts. More experienced INEDs tend to express more objective opinions with higher confidence. Compared with boards with shorter tenure, tenured INEDs participate more in in-depth discussions (Lending and Vähämaa 2017) on topics related to technology challenges and opportunities. Studies investigating the combined effect of board independence and tenure on the extent of ICD are scarce; however, we anticipate that board tenure will moderate the relationship between ICD and INEDs. Therefore, we propose the following hypothesis:

H2: Board tenure moderates the relationship between independent directors and ICD.

Innovation capital disclosure and independent directors in high-technology firms

Innovation is a key factor in the success and competitiveness of technology-intensive firms (Chiu et al. 2021; Gerpott et al. 2008; Gordon et al. 2020; Hirschey et al. 2001; Jia 2019). Firms operating in the high-technology industry, including life sciences (pharmaceutics and biotechnology), computer hardware and electronic equipment, software, and telecommunications, are characterized by their advanced innovation capacities and skilled human capital (Gu and Li 2003). Firms in the high-technology industry are innovative organizations that are well known for their substantial R&D investments to generate knowledge-centered assets (Xu and Li, 2019).

Due to the sensitive nature of innovation information, INEDs may exhibit different behavior in technology-intensive firms. Their conservative behavior is plausible. As innovation is a key contributor to high-technology firms' survival and value creation (Gu and Li 2003), their inclination to prioritize shareholders' interests (Roberts et al. 2005; Przybyłowski et al. 2011) may explain their preference for discretion. Under fierce international competition (Fu 2019), innovation in high-technology firms requires confidentiality

(Glaeser 2018; Jia 2019) and legal protection to maintain their competitive advantage (Xia and Wong, 2020). Proprietary costs (Verrecchia 1983) are relatively higher in technology-intensive firms because of their substantial investments in innovation (Jia 2019; Simpson and Tamayo 2020). As argued by Glaeser (2018), lower disclosure of information about firms' R&D activities and technological progress prevents competitors from replicating firms' new products and technology, thus preserving their competitiveness. Research on disclosure related to the behavior of INEDs to ICD in technology-intensive firms is limited; however, we propose the following hypothesis:

H3: Independent directors affect negatively ICD in high-technology firms.

Research methodology

Sample

Our research examines the content of the corporate websites of SBF 120 listed firms. After excluding firms with missing data, our sample comprised 106 large nonfinancial firms. Table 1 displays the composition of our sample for each sector based on the Global Industry Classification Standard. We referred to the Web-disclosure literature (Gerpott et al. 2008; Orens et al. 2009; Rossi et al. 2018; Striukova et al. 2008) to examine the content of the corporate websites of listed firms over five years (2017–2021). Our study assesses the voluntary disclosure of online innovation capital information communicated in HTML format on corporate websites. The Internet Archive Wayback Machine is used to edit the content of each corporate website. The study focuses on the content of Web pages to capture innovation information revealed in the R&D and innovation section, which is accessible to international stakeholders on corporate websites. Financial and corporate governance information is extracted from the Refinitiv Eikon database. Data regarding the tenure of independent board members and the composition of independent members within the audit committees were extracted manually from the annual reports.

The choice of the French context is motivated by the importance of the implications of R&D disclosure (Lakhal and Dedaj 2020) and the dominance of independent members in the corporate boardroom (Lahyani 2022). In an R&D-oriented economy that focuses on scientific progress (Mardini and Lahyani 2022), the SBF 120 sample dataset includes firms that voluntarily disclose relevant information about their knowledge-based resources (Boujelbene and Affes 2013), which are a key pillar of firm growth (Jia 2019) and value creation (Xia and Wong, 2020). Moreover, previous literature has documented that French firms tend to use the Internet as an effective dynamic communication channel



Table 1 Variable definition

Variable	Definition
ICD	Innovation capital disclosure index
INED	Percentage of independent directors on boardroom
Fdirectors	Percentage of foreign members on boardroom
CEOduality	Dummy variable, which takes a value of 1 if the CEO serves as a top executive and board chairperson and 0 otherwise
INEDtenure	The natural logarithm of the average tenure of independent board members
INEDac	Percentage of independent members in audit committee
IC	Dummy variable, which takes a value of 1 if the board includes the innovation committee and 0 otherwise
Beta	CAPM beta
Size	Logarithm of total assets
ROE	Return on equity
Leverage	Total debt divided by total assets
Δ CE	Capital expenditure growth per year
Δ revenue	Total revenue growth per year
IOwnership	Number of shares owned by institutions divided by the total number of outstanding shares
High-technology	Dummy variable that takes 1 if the firm belongs to high-technology industry and 0 otherwise

to reveal strategic information to a large group of stakeholders and thereby alleviate the limits of annual reports (Boubaker et al. 2012; Gajewski and Li 2015). The advantage of online disclosure is that it provides timely, accessible electronic information at low cost (Gerpott et al. 2008) and offers higher internet visibility (Rossi et al. 2018), enhanced firm value, and lower cost of capital (Orens et al. 2009).

Innovation capital disclosure measure

This study draws on prior literature (Abhayawansa and Guthrie 2016; Bellora and Guenther 2013; Da Silva et al. 2013; Gu and Li 2003; Guthrie and Petty 2000; Hamed and Omri 2013, 2016; Jia. 2019; Lakhali and Dedaj 2020; Orens et al. 2009; Tejedo-Romero et al. 2017; Xia and Wang 2021) to examine the determinants of ICD on corporate websites. Innovation capital combines three dimensions: 1) innovation strategy, 2) innovation input (human capital, R&D progress, and information technology infrastructure), and 3) innovation output (Table 3). Innovation strategy defines how strategic innovation plans may enhance existing technologies and lead to the development of new products (Gu and Li 2003; Xia and Wang 2021). R&D joint ventures and alliances reflect the global dimension of R&D to ensure firm survival (Gu and Li 2003). Innovation input metrics namely, R&D progress, human capital, and information technology infrastructure (e.g., networks and software) provide useful information about the milestones of R&D activities (Gu and Li 2003; Hamed and Omri 2013, 2016; Tejedo-Romero et al. 2017; Xia and Wang 2021). Key innovation progress indicators comprise value-relevant information for stakeholders to

assess the risks and perspectives of ongoing R&D projects. Several indicators related to R&D professionals, including researchers' expertise and training, are decisive (Gu and Li 2003; Hamed and Omri 2016). Skilled human capital is a key resource that enhances a firm's capacity to innovate (Bellora and Guenther 2013). Relevant information about R&D is valuable for investors who are concerned about the firm's prospects and future valuation (Gu and Li 2003). Bellora and Guenther (2013) underscored the importance of networking systems as communication channels that support innovation efforts. Information technology indicators help stakeholders assess technological sophistication levels (Hamed and Omri 2013; Nicolò et al., 2021). To develop their innovation capacities, firms need funds to finance their R&D investments (Gu and Li 2003). Information about innovation outcomes, such as new products, the transfer or sale of new technology, and patents, reflects the degree of creativity and technical progress (Orens et al. 2009; Xia and Wang 2021).

Following previous studies on intellectual capital disclosure (Abhayawansa et al., 2016; Bellora and Guenther 2013; Hamed and Omri 2013; Nimtrakoon 2015; Sardo, et al., 2018), we use content analysis to calculate the ICD index without emphasizing a particular category of stakeholder. This approach is commonly used in the disclosure literature because of its reliability and validity (Gu and Li 2003; Hamed and Omri 2016). Content analysis is an objective method that offers a holistic understanding of the content of different forms of structured financial reporting adapted to both annual reports (Barros et al. 2013; Da Silva et al. 2013; Mardini and Lahyani 2022) and corporate websites



(Gajewski and Li 2015). We ensured the accuracy of our manual coding process by double-checking the information collected from the websites of 10 randomly chosen firms over a five-year period. Table 3 lists the innovation items for each category. For each firm, disclosure is a combined score scaled by the maximum potential score, where the total number of innovation items is 35. The overall ICD score is calculated as follows:

$$ICD_{it} = \frac{\sum_{i=1}^M d_{it}}{M}$$

d_{it} is the score given to each innovation capital item. M corresponds to the total number of innovation capital items.

Model specification

This study examines the relationship between board independence and ICD provided by French-listed firms using pooled ordinary least squares (OLS), random effects, and generalized method of moments (GMM) models. We build on previous literature (James et al. 2021) and use pooled OLS models with heteroskedasticity robust standard errors that consider industry and time effects. Based on the reported Hausman statistics, the random effects regressions are more appropriate for our panel dataset with time-invariant governance variables than the fixed-effects regressions (Table 6). The GMM approach is used to counter endogeneity concerns in the full sample and subsamples that distinguish high-technology firms from non-high-technology firms. High-technology industries refer to firms operating in life sciences, computer hardware and electronics, software, and telecommunications (Gu and Li 2003). The following multivariate models are tested:

$$ICD_{it} = \beta_0 + \beta_1 INED_{it} + \beta_2 controls_{it} + \varepsilon_{it} \quad (1)$$

$$ICD_{it} = \beta_0 + \beta_1 INED_{it} + \beta_2 INED \times INEDtenure_{it} + \beta_3 controls_{it} + \varepsilon_{it} \quad (2)$$

$$ICD_{it} = \beta_0 + \beta_1 ICD_{it-1} + \beta_2 INED_{it} + \beta_3 controls_{it} + \varepsilon_{it} \quad (3)$$

$$ICD_{it} = \beta_0 + \beta_1 ICD_{it-1} + \beta_2 INED_{it} + \beta_3 INED \times INEDtenure_{it} + \beta_4 controls_{it} + \varepsilon_{it} \quad (4)$$

where ICD_{it} represents web innovation capital disclosure. Our main independent variable includes INEDs. Control variables include INEDs' board tenure (INEDtenure), audit committee independence (INEDac), foreign directors (Foreignd), CEO duality, and innovation board committee (IC). Firm characteristics include systematic risk (beta), firm size (size), firm profitability as measured in terms of ROE, leverage, capital expenditure growth (ΔCE), revenue growth

($\Delta revenue$), and institutional ownership (IOwnership). Previous studies have reported that these variables are likely to influence intellectual capital disclosure (Da Silva et al. 2013; Mardini and Lahyani 2022; Tejedro-Romero et al. 2017; Xia and Wang 2021). Table 2 defines the variables used to test our set of hypotheses.

Results

Descriptive analysis

Innovation capital disclosure characteristics

We show that ICD varies across sectors (Table 2). As expected, the communication sector and the information technology sector (including software and services, technology hardware and equipment, semiconductors, and semiconductor equipment) exhibit relatively low innovation disclosure levels, with a mean value of 0.45 and 0.51, respectively. Despite the importance of intangibles for firm growth, telecommunication network operators voluntarily disclose a relatively low volume of information about their innovation capital proxies. This is partly because of aggressive competition and the fear of losing the firm's competitive advantage (Gerpott et al. 2008).

Table 3 reports the mean ICD scores for different innovation dimensions based on content analysis. French-listed firms are likely to disclose online information related to innovation capital, which includes innovation strategy, innovation input, and innovation output (disclosure items 1–35). Online disclosure seems to be a useful form that ensures timely interactions with firm stakeholders, such as investors, regarding the firm's innovation opportunities. In line with the agency perspective (Glaeser 2018; Goebel 2019; Gu and Li 2003; Jia 2019), our findings indicate that French firms actively respond to the information needs of a wide-ranging stakeholder group by disclosing relevant

Table 2 Innovation capital disclosure per sector

GISC sector	Sampled firms (%)	ICD
Communication services	5.7	0.45
Consumer discretionary	16	0.59
Consumer staples	12.3	0.68
Energy	9.4	0.53
HealthCare	20.8	0.54
Industrials	9.4	0.57
IT	7.5	0.51
Material	6.6	0.6
Real estate	6.6	0.66
Utilities	5.7	0.61



Table 3 Innovation capital disclosure dimensions

	Innovation capital item	Mean
<i>I-Innovation strategy</i>		
1	Innovation strategy	1
2	Innovation programs	0.974
3	R&D strategy	0.870
4	R&D programs	0.721
5	Acquisitions	0.634
6	Forms of R&D joint ventures and alliances	0.825
7	R&D financing	0.343
<i>II-Innovation input</i>		
8	Human capital per R&D project	0.653
9	Information about R&D team	0.860
10	Professional development	0.460
11	R&D costs	0.751
12	R&D first stage	0.494
13	R&D development stage	0.358
14	Ongoing research projects	0.577
15	Breakthrough of R&D	0.658
16	R&D prospects	0.640
17	R&D invested in product development	0.438
18	Outcomes per R&D project	0.511
19	New aspects of products under development	0.613
20	Time schedule per R&D project	0.462
21	IT investments	0.355
22	IT systems	0.819
23	Software	0.836
24	Networks	0.747
25	IT benefits	0.949
26	IT costs	0.742
<i>III-Innovation output</i>		
27	Trademarks	0.140
28	Copyrights	0.111
29	Number of Patents and licenses	0.955
30	Patents pending	0.036
31	Details of firm Patents	0.068
32	Awards	0.085
33	Market share-new products	0.234
34	New products	0.762
35	Transfer or sale of technology	0.642

information about their innovation capital through their corporate websites.

Descriptive statistics

Table 4 exhibits the descriptive statistics. Our overall ICD score varies between 0.11 and 0.94, with a mean value of

Table 4 Descriptive analysis

	Mean	Standard deviation	Minimum	Maximum
ICD	0.58	0.2	0.11	0.94
INED	0.55	0.19	0.11	1
Foreignnd	0.23	0.23	0	1
CEOduality	0.63	0.48	0	1
INEDtenure	6.78	2.89	1	19.5
INEDac	0.87	0.11	0.75	1
IC	0.12	0.32	0	1
Beta	0.97	0.46	-0.21	3.81
Size	22.91	2.03	8.89	26.4
ROE	0.07	0.23	-1.88	1.08
Leverage	0.64	0.17	0.1	1.2
ΔCE	0.1	0.72	-0.92	11.4
Δrevenue	0.05	0.16	-0.59	0.93
IOwnership	0.34	0.26	0	0.9
High-technology	0.31	0.4	0	1

0.58. Nicolò et al. (2021) reported higher Web intellectual capital disclosure for Italian universities, with an average value of 0.74. Gerpott et al. (2008) reported that the telecommunications industry has low intangible disclosure levels on its corporate website. Similar findings were reported by Da Silva et al. (2013) in the context of R&D-intensive firms in Finland and Sweden. The proportion of INEDs in the boardroom varies between 11 and 100%, with a mean value of 55%, while foreign directors represent an average of 23%. The average board tenure of independent members is 6.78, while the proportion of independent members in the audit committee with a financial background is 83%. About 12% of the sample firms include board innovation committees.

Table 5 exhibits the Pearson correlation matrix. The reported correlation values are low, indicating the absence of multicollinearity concerns. The correlation between ICD and INEDs is negative, encouraging lower disclosure levels.

Regression analysis

Table 6 reports the regression results based on the pooled OLS, random effects, and GMM models. The study tests two opposing hypotheses, transparency (H1a) versus discretion (H1b), to explain the behavior of INEDs in relation to ICD. The estimated coefficient for INEDs ($\beta = -0.17$, $p = 0.02$) shows a negative significant relationship between the INEDs variable and ICD at a 5% significance level in Model 1, supporting the discretion hypothesis (H1b). Similar results are obtained in Model 2. Our evidence is persistent and robust when considering endogeneity concerns in Model 3, based on the GMM approach. Our results suggest that



Table 5 Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 ICD	1													
2 INED	-0.09*	1												
3 Foreignnd	0.11*	0.3*	1											
4 CEOduality	0.17*	-0.20*	-0.10*	1										
5 INEDtenure	-0.09*	-0.15*	-0.16*	0.23*	1									
6 INEDac	-0.001	0.18*	0.09*	0.07	0.004	1								
7 IC	0.09*	-0.06	-0.11*	0.09*	-0.08	-0.11*	1							
8 Beta	0.06	0.18*	0.25*	-0.20*	-0.13*	0.24*	0.04	1						
9 Fsize	0.19*	0.11*	0.18*	0.23*	0.05	0.27*	-0.03	-0.01	1					
10 ROE	0.003	-0.07	-0.01	0.09*	0.09*	-0.23*	-0.06	-0.31*	0.06	1				
11 Leverage	-0.02	0.04	-0.06	0.03	-0.09*	0.10*	0.04	0.016*	0.33*	-0.07	1			
12 ΔCE	0.01	0.07	-0.003	0.04	-0.06	0.03	0.03	0.01	0.002	0.01	0.03	1		
13 Δrevenue	-0.06	-0.05	-0.07	-0.01	-0.07	-0.09*	-0.05	-0.21*	-0.18*	0.19*	-0.11*	0.003	1	
14 IOwnership	0.02	-0.15	-0.02	-0.05	-0.09*	-0.11*	-0.01	-0.1*	-0.11*	0.08	-0.16*	-0.005	0.03	1

* Significant at the 5% level

Table 6 Regression results: Innovation capital disclosure and independent directors

	OLS	Random effects	GMM	OLS	Random effects	GMM
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
ICD _{t-1}			0.41 (0.02)**			0.18 (0.02)**
INED	-0.17 (0.02)**	-0.19 (0.04)**	-0.21 (0.04)**	-0.17 (0.02)**	-0.09 (0.06)*	-0.19 (0.00)***
INED*INEDtenure				-0.28 (0.03)*	0.06 (0.04)**	0.61 (0.02)**
Foreignnd	-0.04 (0.08)*	0.05 (0.04)**	0.07 (0.01)**	-0.06 (0.01)**	0.01 (0.09)*	0.05 (0.3)
CEOduality	0.01 (0.06)*	-0.002 (0.62)	0.002 (0.65)	0.02 (0.01)**	0.0009 (0.8)	-0.008 (0.8)
INEDtenure	-0.003 (0.03)**	0.002 (0.04)*	0.004 (0.03)**	-0.004 (0.03)**	0.01 (0.02)*	0.01 (0.02)**
INEDac	0.02 (0.08)*	0.01 (0.35)	-0.02 (0.27)	0.02 (0.08)*	0.007 (0.2)	0.001 (0.9)
IC	0.09 (0.50)	0.008 (0.21)	-0.004 (0.74)	0.09 (0.50)	0.007 (0.2)	0.002 (0.7)
Beta	0.03 (0.01)**	-0.002 (0.96)	0.004 (0.48)	0.03 (0.01)**	-0.008 (0.09)*	0.002 (0.7)
Size	0.01 (0.00)***	0.01 (0.03)**	0.01 (0.00)***	0.01 (0.00)***	0.01 (0.04)**	0.009 (0.09)*
ROE	0.01 (0.35)	-0.002 (0.74)	0.01 (0.19)	0.01 (0.35)	0.009 (0.9)	0.03 (0.2)
Leverage	-0.04 (0.28)	-0.03 (0.30)	-0.01 (0.74)	-0.04 (0.28)	-0.02 (0.4)	-0.03 (0.3)
ΔCE	0.001 (0.82)	-0.008 (0.72)	-0.006 (0.76)	0.001 (0.82)	-0.004 (0.5)	0.004 (0.5)
Δrevenue	0.01 (0.57)	0.001 (0.9)	-0.002 (0.83)	-0.007 (0.9)	-0.002 (0.7)	-0.007 (0.3)
IOwnership	-0.002 (0.91)	0.01 (0.72)	0.01 (0.45)	-0.002 (0.2)	0.002 (0.8)	-0.006 (0.5)
Constant	-0.12 (0.28)	-0.06 (0.67)	-0.03 (0.88)	-0.25 (0.11)	0.04 (0.7)	-0.07 (0.6)
Industry/year effects	Yes	Yes	Yes	Yes	Yes	Yes
R2 (overall)	0.356	0.327		0.3665	0.334	
Hausman test (p-value)		21.46 (0.49)			8.75 (0.9)	
No. of groups	105	105	105	105	105	105
No. of instruments			32			33
Arellano-Bond test -AR (1) (p-value)			-2.78 (0.005)			-2.16 (0.03)**
Arellano-Bond test -AR (2) (p-value)			1.013 (0.31)			0.26 (0.79)
Sargan test of overidentification (p-value)			14.70 (0.14)			15.90 (0.09)

p-values are reported in italic

***, ** and * denote significance at 1, 5 and 10% levels, respectively



INEDs exhibit risk-averse behavior by exerting significant pressure to withhold online information about innovation capital. In line with the resource-dependence theory (Hillman et al. 2000; Pfeffer and Salancik 1978), our findings show that external directors, who are recognized for their strategic guidance and objective opinions (Deutsch 2005), tend to play an important role in determining the extent of strategic information (Hassan and Lahyani 2020). INEDs are experienced professionals who bring competencies and experience (Khatib et al. 2020; Przybyłowski et al. 2011). In line with previous intellectual capital disclosure studies, our findings suggest that INEDs tend to divulge less information about innovation capital to stakeholders (Kusumawardani et al. 2021; Tejedo-Romero et al. 2017) via their corporate websites. Their skepticism is plausible because innovation capital is viewed as the driving force of a firm's success (Gu and Li 2003; Simpson and Tamayo 2020). The INEDs seem to encourage a balance between safeguarding the firm's competitive advantage and responding to stakeholders' pressure for higher transparency. This implies a limited volume of information revealed to stakeholders, considering the firm's external environment and the strategic nature of knowledge-based resources (Castilla-Polo and Ruiz-Rodríguez 2017). Coherent with proprietary cost arguments (Verrecchia 1983), our findings suggest that INEDs raise concerns about the benefits of disclosing firms' R&D phases, human capital competencies, and technological advances to competitors without appropriate legal protection. This cautious approach is driven by the potential risk of losing the firm's competitive advantage.

Models 4 to 6 show the effects of the interaction variable (INED* INEDtenure) on ICD. The relationship between INEDs with long board tenure and ICD is positive and statistically significant, regardless of the estimation method. Our evidence supports H2, which posits that board tenure moderates the relationship between INEDs and ICD. Consistent with resource-dependence arguments (Hillman et al. 2000; Pfeffer and Salancik 1978), our findings suggest that tenured INEDs add value to the boardroom and shape disclosure policies (James et al. 2021). Longer-tenured directors are generally experienced directors who deepen the board's understanding of the industry and allow better analysis of stakeholders' requirements. The incentives for boards with a higher proportion of independence and longer tenure to increase ICD are in line with the principles of agency theory (Fama and Jensen 1983; Gajewski and Li 2015; Li et al. 2008; Rodrigues et al., 2017). This alignment is driven by the importance of resources allocated to R&D investments and the uncertain nature of innovation outcomes. Tenured INEDs support

higher ICD as a valuable interactive channel that links firms to a varied stakeholder group to decrease information asymmetry because information about innovation projects is not reported in conventional financial reports. Considering the rapid developments in communication technologies and fierce competition, our findings suggest that experienced, high-tenured INEDs are more prone to support the modernization of firms' information disclosure to stakeholders. High-tenured outsiders are more likely to support the quicker dissemination of narrative information about innovation investments with higher accountability enabled by the online channel. Contrary to the standard disclosure format, tenured INEDs tend to encourage revealing of online information to a large range of global stakeholders, such as investors, to meet their information needs. This approach of tenured INEDs can be attributed to the internationalization of firm business activities (Boubaker et al. 2012; Rossi et al. 2018). Our evidence is in line with the view that qualified INEDs with varied educational backgrounds and longer tenures may improve the informational environment (James et al. 2021), the effectiveness of the board (Fedaseyeu et al. 2018; Reguera-Alvarada and Bravo, 2017), and the strategic decision-making process (Salehi and Zimon 2021). Our findings support prior studies (Chin et al. 2006; Gu and Wang 2005; Guo and Zhou 2016; Hamed and Omri 2016) that outlined the importance of disclosing knowledge-based information to external stakeholders to help them access the underlying innovation risks and opportunities (Chin et al. 2006).

This study distinguishes between technology-intensive firms and nontechnology-intensive firms. It aims to ascertain whether the relationship between INEDs and ICD differs across high-technology firms that are characterized by their dependence on innovation. Table 7 shows the GMM regression results. The consistent results for the INEDs variable in Models 7 and 8 validate the robustness of our study, supporting the discretion hypothesis (H3) in high-tech firms. The effect of INEDs on ICD ($\beta = -0.26, p < 0.05$) is more pronounced in high-tech firms compared to non-high-technology firms ($\beta = -0.18, p < 0.1$). Our findings suggest that INEDs who serve in high-technology firms encourage withholding relevant information on innovation capital, a key pillar that ensures a firm's growth and competitive advantage. Compared with conventional firms, high-technology firms embody a distinguished innovation ability driven by talented human capital and advanced technologies (Gu and Li 2003; Nimtrakoon 2015). A plausible explanation for their conservative behavior is consistent with proprietary cost arguments (Simpson and Tamayo 2020; Verrecchia 1983), which target protecting the intellectual proprietary



Table 7 GMM results: Innovation capital disclosure and independent directors in high-technology firms

	Non-high technology firms	High-technology firms
Variables	Model 7	Model 8
ICD _{t-1}	0.42 (0.03)**	0.46 (0.01)**
INED	-0.18 (0.07)*	-0.26 (0.01)**
Foreignnd	0.10 (0.001)***	0.06 (0.01)**
CEOduality	0.01 (0.02)**	-0.01 (0.09)*
INEDtenure	0.003 (0.08)*	0.01 (0.04)**
INEDac	0.01 (0.07)*	0.04 (0.005)***
IC	0.02 (0.00)***	-0.01 (0.87)
Beta	0.005 (0.42)	-0.003 (0.95)
Size	0.02 (0.00)***	0.01 (0.00)***
ROE	0.004 (0.64)	0.04 (0.02)*
Leverage	-0.04 (0.30)	0.08 (0.07)*
Δ CE	0.001 (0.93)	-0.07 (0.04)*
Δ revenue	-0.01 (0.24)	0.005 (0.82)
IOwnership	-0.01 (0.28)	0.02 (0.31)
Constant	-0.27 (0.33)	0.45 (0.37)
No. of observations	180	93
Year effects	Yes	Yes
No. of groups	64	32
No. of instruments	30	30
Arellano-Bond test -AR (1) (<i>p</i> -value)	1.64 (0.04)	-2.84 (0.02)
Arellano-Bond test -AR (2) (<i>p</i> -value)	0.33 (0.73)	1.36 (0.18)
Sargan test of overidentification (<i>p</i> -value)	13.35 (0.20)	14.12 (0.16)

p-values are reported in italic

***, ** and * denote significance at 1, 5 and 10% levels, respectively

rights of high-technology firms whose survival depends on the outcomes of R&D activities (Gordon et al. 2020) in the context of aggressive competition.

Conclusion

This study examines whether corporate governance mechanisms determine the extent of the ICD of SBF 120 nonfinancial firms. To test our hypotheses, we use multivariate models based on pooled OLS, random effects, and GMM models. The study enhances understanding of the motives of INEDs to withhold information about innovation capital on corporate websites in the era of digital technologies. The study is motivated by the scarcity of evidence on the influence that INEDs exert on ICD, despite the growing interest in innovation and knowledge-based resources. From a resource-dependence perspective, INEDs are resource providers due to their deep industry knowledge and expertise. In line with agency theory, our findings suggest that French firms are likely to use ICD as a useful form of communication to

ensure quicker dissemination of narrative information, and thereby to decrease agency conflicts, in a knowledge-based economy. In line with proprietary cost arguments (Verrecchia 1983), INEDs support discretion in disclosing the firm's R&D progress and innovation output to protect the firm's intellectual property and, therefore, shareholders' interests in the context of fierce global competition. This study distinguishes technology-intensive firms, which are well known for their substantial investments in technological innovation to survive, from nontechnology-intensive firms. INEDs tend to affect ICD practices and encourage maintaining a balance between preserving the firm's competitive advantage and responding to stakeholders' calls for higher transparency. As innovation-centered assets are not recognized in annual reports, our findings suggest that INEDs across technology-intensive firms tend to delimit disclosure about the firm's innovation breakthroughs. This is plausible given the importance of innovation to firms' survival, which necessitates substantial investments with extensive explorations, uncertain outcomes, and delayed payoffs. Furthermore, our findings reveal that board tenure moderates the relationship



between INEDs and ICD. We argue that long-tenured INEDs are better equipped to assess technology challenges and opportunities, leading to superior monitoring of resources related to innovation capital.

This paper provides significant insights for management, policy-makers, and regulators who are concerned about the board's optimal composition and are involved in refining corporate reporting practices related to innovation capital information, which is a key pillar in ensuring a firm's growth and helping investors make appropriate investment decisions. In a digital era characterized by rapid technological and knowledge change, managers, policy-makers, and regulators need to shift from paper-based disclosure to digital disclosure in order to communicate directly with the firm's stakeholders, such as capital providers. It is important to revolutionize the way information about innovation is divulged to stakeholder groups in knowledge-based economies and to consider the advantages and costs of the online voluntary disclosure of innovation information. This study provides evidence that qualified INEDs in the boardroom are shareholder-oriented and shape strategic choices, such as online innovation disclosure. Management action is needed to optimize the board's composition and to encourage objective and transparent recruitment procedures for board leadership positions based on merits and competence to ensure the protection of shareholders' and stakeholders' interests.

This study is subject to some limitations. Future research may include a wider pool of corporate governance variables, such as the proportion of female directors on boards, and focus on different settings with larger datasets, to examine the generalizability of our findings. In view of data restraints, our study uses INEDs' tenure and contribution to audit committees and omits the effects of other director characteristics, such as multiple directorships. Future research may use textual analysis to address the shortcomings of content analysis and to test the consistency of our results.

Funding Open Access funding provided by the Qatar National Library.

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