

A Cognitive Approach to Diversity: Investigating the Impact of Board of Directors' Educational and Functional Heterogeneity on Innovation Performance

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Abstract

Boards' diversity has been studied mainly through the prism of ethics, which translated into a focus on characteristics such as gender and ethnicity. However, when the goal is to explain organizational outcomes, the cognitive approach seems more pertinent. Thus, rooted in a resource dependency perspective, this paper investigates the potential impact of directors' deep-visible diversity (functional and educational diversity) on innovation performance based on an international sample of 97 firms for a total of 1027 directors. The findings highlight the negative effect of functional diversity (measured by diversity in the sectors of expertise), and on the opposite, the positive impact of educational diversity (measured by diversity in the fields of study) on innovation performance. This study also shows that the environment in which organizations evolve, both at the internal and external level, is crucial when it comes to innovation performance. These results are robust in that they remain consistent after addressing some potential endogeneity issues and have critical implications for both the professional and academic world.

Keywords: Board diversity, cognitive approach, function, education, innovation performance, resource dependency theory

1. Introduction

Innovation plays a crucial role in the growth and sustainability of firms (Kor, 2006, Lumpkin and Dess, 1996, Stopford and Baden-Fuller, 1994, Torchia et al., 2011, Zahra, 1996), but its benefits can often only be seen in the long term (Hoskisson et al., 1993, Lee and O'Neill, 2003). Among these benefits, we count the increase in market share (Banbury and Mitchell 1995, Franko 1989, Robinson 1990) and the contribution to the development of competitive advantages (Hitt et al., 1996; Chen et al., 2006; Ireland and Webb, 2007; Reed et al., 2012). Andresen et al. (2002) attributed other three distinct benefits to innovation: efficiency, effectiveness and performance. Moreover, innovation is closely linked to firm financial performance (Bigliardi, 2013; Carter, 1990; Gök and Peker, 2017) and helps organizations in coping with competition (Aghion et al., 2005; Boutellier et al., 2008; Calantone et al., 2002; Clark and Guy, 1998). Thus, it becomes particularly relevant to focus on its potential catalysts.

For these purposes, scholars have focused on employees' diversity and suggested that heterogeneous profiles make the organization more open to new ideas and better able to take advantage of external knowledge (Cohen and Levinthal, 1990). It has also been argued that diversity generates new combinations of internal knowledge, superior problem-solving skills, the emergence of new ideas, and leads to better exploitation of knowledge (Østergaard et al., 2011; Woodman et al. 1993). In addition, it is seen as a source of creativity, would lead to more optimal sharing of information, reflexivity of tasks (Dahlin et al., 2005) and can influence innovation mainly through the presence of employees who have followed advanced and diverse studies (Østergaard et al., 2011). In this sense, a positive link between employees' diversity and innovation has been established by several studies (e.g., Díaz-García et al., 2013, Yang and Konrad, 2010). However, we most point out that this link has not been consistently positive (Cheung et al., 2016), which shows that empirical evidence remains inconclusive

and that more studies are needed.

Another line of research has been to consider corporate governance as a key element for innovation (Talke et al., 2010, Zona et al., 2013). However, the corporate body that has received the most attention when it comes to studying this link is the top management team (TMT), with several studies reporting a positive link between TMT' diversity and innovation (e.g., Alexiev et al., 2010, Chen et al., 2015, Kor, 2006, Talke et al., 2010, 2011, Yadav et al., 2007). These findings can notably be explained by the capacity of heterogeneous groups to cope with the changes and consequences of breakthrough innovation (Lyon and Ferrier, 2002), by some managers attributes such as their education and professional experience (Bantel and Jackson, 1989), as well as their functional expertise (Hoffman and Hegarty, 1993). Thus, even if extant research studying the impact of TMT' diversity on innovation has not consistently supported the positive sign thesis (Daellenbach et al., 1999), as it is the case for employees' diversity, the literature suggests that the positive link is the more plausible.

These observations set the ground to direct our attention to another corporate body: the board of directors (BoD). This choice is justified by the fact that, despite interesting contributions made on the link between corporate governance and innovation, mainly at the TMT' level, studies on this theme remain rare (Honoré et al., 2015). Thus, the present research aims to fill this gap in the literature by shedding the light on how boards could affect innovation, especially given its role in nurturing it (Jaskyte, 2012) mainly through its resource allocation responsibility (Lynall et al., 2003, Miller and Triana, 2009, Pfeffer and Salancik, 2003), its influence at the strategic level (Hillman et al., 2000, McNulty and Pettigrew, 1999) and its contribution to value creation (Shleifer and Vishny, 1997, Carter et al., 2003). In addition to being rather rare, the relatively scarce work on the relationship between the BoD and innovation has often failed to establish direct links (Baysinger et al., 1991, Hoskisson et al., 2002), which is another element that makes the relevance of this study. Moreover, and while diversity has historically been a poorly represented concept in the strategic management literature (Dwyer et al., 2003), this scarcity is even more pronounced when it comes to the relationship between diversity and innovation (Bantel and Jackson, 1989; Díaz-García et al., 2013, Østergaard et al., 2011, Van der Vegt and Janssen, 2003).

Furthermore, while some studies have reported a positive impact of BoD's diversity on innovation (e.g., Midavaine et al., 2016, Miller and Triana, 2009), they remain plagued with many limitations, such as the consideration of a very small number of diversity types (Midavaine et al., 2016; Sarto et al., 2019), or the focus on only "visible types of diversity" such as those related to gender and ethnicity (Cady and Valentine, 1999, Kang et al., 2007). Thus, consistent with the reflection of some scholars (e.g., Mahadeo et al., 2012, Torchia et al., 2015), we consider that less-visible diversity such as functional and educational diversity could have a greater explanatory power regarding possible organizational outcomes such as innovation performance. In this sense, we favour a cognitive approach rather and ethical one, of course without disparaging the importance of the latter and by considering different levels of diversity (Akbar & Khan, 2016). Our focus on "less-visible diversity" is also supported by the fact that this category of diversity is considered as a potential vector of innovation, as it refers to the knowledge, skills and abilities it would provide to senior managers (Kor, 2006).

All these elements together justify the need of exploring further the link between boards' diversity and innovation performance. To that end, this study aims to answer the following main research question: What is the impact of BoD' deep-visible diversity on innovation performance? It more specifically tackles these four sub questions:

- What is the impact of BoD' functional diversity in terms of fields of expertise on innovation performance?
- What is the impact of BoD' functional diversity in terms of sectors of expertise on innovation performance?
- What is the impact of BoD' educational diversity in terms of study fields on innovation performance?
- What is the impact of BoD' functional diversity in terms of study levels on innovation performance?

The remainder of the paper is structured as follows. Section 2 presents our literature review, theoretical foundations, and hypotheses development. Section 3 details the methodology. Section 4 displays our results and a discussion surrounding them. Finally, section 5 consists of a conclusion that notably exposes our main contributions as well as some limitations inherent to this study and avenues to guide future research on the link between board diversity and innovation performance.

2. Literature Review, Theoretical Foundations and Hypotheses

Resource dependence theory (RDT) highlights the resource provision and allocation role of directors to reduce firm uncertainty. It stipulated that the BoD should facilitate the access of firms to the scarce and critical resources it needs, such as, information, technology, and financial capital (Pfeffer & Slancik, 2003). In addition to their role in reducing firm uncertainty, directors should also provide the organization with other valuable

resources such as skills, specialized and general expertise, strategic and functional advice, working knowledge and alternative points of view (Pfeffer & Slancik, 1978; Mizruchi, 1983; Hillman et al., 2000; Baysinger & Zardkoohi, 1986; Johnson et al., 1996). While there are many studies on the role of directors based on a resource dependency perspective, it is worth noting that the literature using this theory and dealing with innovation remains scarce (Hillman et al., 2009). This is particularly problematic given that among the valuable resources associated with traditional measures of innovation such as research and development (R&D) are board members' specific knowledge and their ability to build relationships between their company and its broader environment (Xie & O'Neill, 2013).

In this continuity, RDT proves to be more relevant to analyse the different roles of BoD than other dominant theories such as agency theory (AT) (Hillman et al., 2009). This is especially the case when investigating its influence in stimulating and supporting innovation (Jaskyte, 2012). Indeed, it has been argued that AT does not provide the relevant theoretical framework to study the relationship between the BoD and expenses in R&D or innovation (Kor, 2006). Also, while some authors have attributed this theory the responsibility of the inconsistent results regarding the effect of the BoD on various organizational outcomes (Dalziel et al., 2011; Hillman et al., 2003; Minichilli et al., 2009), others have also argued that the role of the BoD in providing resources to its firm has more potential to link directors to corporate performance (Hillman & Dalziel, 2003; Kim, 2015). Furthermore, beyond the need of minimizing agency costs, which remain an important role for any BoD set of duties (Jensen, 1993), the allocation of resources and the setting of firm strategic direction become as important (McNulty & Pettigrew, 1999; Hillman et al., 2000; Hillman & Dalziel, 2003).

In this sense, some BoD' attributes, such as those related to the diversity of its members, can greatly contribute fulfilling these roles. For instance, it could stimulate the creativity inside the boardroom through the plurality of ideas it generates (Kor, 2006; Miller & Triana, 2009; Milliken & Vollrath, 1991). This could explain why diversified BoDs could help enhancing innovation performance (Bernile et al., 2018, Miller & Triana, 2009). Jaskyte (2012) went so far as to assert that it is the BoD that would set the tone to meet the challenges facing the firm, especially those that meet the expectations of innovative thinking and creative approaches. Thus, the impact of board diversity on innovation could come from different sources, such as the ability of directors to find innovative ideas and solutions, as well as their contribution in the acquisition of resources required to seize innovation opportunities (Miller & Triana, 2009). It could also lie in the fact that it encourages board members go beyond their traditional roles such as that of control (Haynes & Hillman 2010, Minichilli et al., 2009).

The evolution of boards' roles also induces that today, we expect them to contribute shaping an organizational context that facilitates and supports leaders in their quest for innovation (Crespell & Hansen, 2008; Zona et al., 2013). This could be done, for example, by providing the direction and support to management in making risky investments like those needed to innovate (Kim, 2015). However, up until now, the concept of diversity has been studied mainly through the prism of ethics, which translated into a focus on characteristics such as gender and ethnicity. Nonetheless, when the goal is to explain organizational outcomes, the cognitive approach seems more pertinent. In advocating that position, it has been suggested that "less-visible variables" would have a greater impact than the characteristics over which no control can be exercised (Torchia et al., 2015), especially for a complex matter like innovation (Sarto et al., 2019). Thus, it becomes interesting to focus on the most common diversity types from a cognitive perspective, that are also presented as "less-visible variables" or under the appellation "deep-visible diversity": functional and educational diversity.

2.1 Functional Diversity and Innovation

RDT postulates that BoDs are generally composed of members with diverse skills such as lawyers or financial officers who are expected to make significant contributions related to their field of expertise (Hillman & Dalziel, 2003). Furthermore, directors are supposed to act as a provider of resources, ideas, and relationships that could increase the innovation capabilities of their organization (Miller & Triana, 2009). Thus, it becomes relevant to focus on directors' functional diversity. This type of diversity generally refers to the fields of expertise (e.g., medicine, finance, and human resources) (Kor, 2006). Bear et al. (2010) emphasized its importance in corporate governance by indicating that resources related to BoD' capital are based on all the experience and expertise of directors. In addition, these authors underlined that diversity of experiences has proven to be a driving force for innovation in many studies on management teams. In addition to being a carrier of breakthrough innovation, functional diversity based on the fields of expertise would help groups in generating more novel ideas and improve strategic advice (Daveri & Parisi, 2015; Dou et al., 2015, Van der Vegt & Janssen, 2003), which tends in turn to improve firms' innovation (Daellenbach et al., 1999, Wincent et al., 2010).

More importantly, a BoD whose members have held various positions would promote strategic change (Tarus &

Aime, 2014) and lead to better decision-making (Bantel, 1993), both necessary to foster innovation. In the same vein, Wincent et al. (2014) found that diversity in the fields of expertise was positively and significantly related to firm entrepreneurial orientation, while Kor (2006) pointed out that it could have a significant impact in managing R&D investments, which might lead to innovation. Furthermore, previous studies having investigated on the nomination of women and minorities into the BoD were mainly motivated by social, legal or normative reasons. However, there were implicitly, and sometimes even explicitly, based on the argument that these two types of diversity would generate a wider range of expertise (Hillman et al., 2003). Therefore, visible characteristics (e.g., ethnic diversity), as defined by several authors (Cady & Valentine, 1999, Erhardt et al., 2003, Mahadeo et al., 2012), appear to be a relevant resource at the board level mainly when it can provide it with “non-visible characteristics” such as those related to diversity in the fields of expertise. In other words, visible diversity would be pertinent when it provides nonvisible diversity. Finally, BoD’ functional diversity could also allow it to better understand its environment and improve its ability to solve problems (Bear et al., 2010), especially through the practical knowledge that its members usually have (Heyden et al., 2015) and which represent valuable assets for innovative purposes. Considering the arguments presented in this section, we posit that:

H_{1a}: BoD’ functional diversity in terms of fields of expertise is positively related to innovation performance.

Functional diversity is not limited to the fields of expertise but may also relate to the sectors of expertise (e.g., oil, banking and pharmaceutical). On this point, Kor and Misangyi (2008) have emphasized the importance of industry-specific expertise by indicating that it would help to anticipate some strategic actions. According to these same authors, directors who have worked in a specific sector would develop knowledge and reflexes that require a lot of time to be assimilated and that can be of great help when it comes to provide input for firm innovation. In the same vein, directors with sector-specific experience would be endowed with better abilities to evaluate innovation opportunities in the given sector, up to date with the latest technologies used in the industry and have better information about competitors, customer needs, supplier capabilities and regulations (Chen, 2014). On a similar position, Barroso et al. (2011) have argued that a specific experience in a single industry rather than in various industries ensures that directors have a thorough knowledge of how the industry operates and of the different stakeholders within it. Board members with an expertise in the focal industry of their current organization are also essential because they can make the latter benefit from their contacts with key suppliers and customers as well as their access to technical resources (Rosenstein, 1988).

These elements suggest that having an heterogenous BoD in terms of sectors of expertise could be particularly problematic. Indeed, it would inevitably result in having less directors with a deep knowledge of their current firm’s sector. The problem is that, for board members to be able to provide the resources, advice and relationships needed for innovation, it seems fundamental that they reflect an extensive experience in their firm’s sector. This is especially true given that firms differ from one industry to another, which requires them to manage different kind of resources and capabilities, and consequently to have directors that are familiar with their firm’s sector mechanisms to guide it adequately (Kor, 2003). Also, it has been advanced that directors’ industry-specific expertise shapes their cognitive functioning (Barroso et al., 2011; Tian et al., 2010). Thus, having a diverse BoD at this level could lead to oppositions and misunderstandings because each member is retreating to their certainties. This is even more plausible knowing that the concept of diversity has been linked to various potential issues such as communication and coordination problems (Goodstein et al., 1994; Ingley & van der Walt, 2003), that might hinder the potential impact of directors on innovation performance. In this sense, and contrary to what has been advanced for the diversity in the fields of expertise, it seems that firms would benefit from ensuring that their BoD are not too heterogenous in terms of directors’ sectors of expertise. This would help creating better conditions for the BoD to contribute to innovation performance by ensuring that most of their members have a deep knowledge of their current firm’s sector. From this discussion emanates the following hypothesis:

H_{1b}: BoD’ functional diversity in terms of industry-specific expertise is negatively related to innovation performance.

2.2 Educational Diversity and Innovation

Corporate governance research suggests that managers’ knowledge is not necessarily an isolated variable, as it was closely related to professional experiences (Kor & Sundaramurthy, 2009). It also supports the idea that diversity can be relevant at all organizational levels, and when examined it at the higher levels, it is worth noting that the academic background is one of the most frequently analyzed aspects (Wiersema & Bantel, 1992). This line of research has notably shown that the knowledge acquired from academia is considered as a key resource given its potential to foster innovation and to lead to the acquisition of a competitive advantage (Kor &

Sundaramurthy, 2009; Zahra & Pierce, 1989). Emphasizing the relevance of director's knowledge, Torchia *et al.* (2015) have raised the interest of analyzing "less-visible variables" such as those related to directors' background, which could be explained by the fact that aspects such as directors' knowledge would influence their decisions (Mahadeo *et al.*, 2012).

It has also been argued that having on the BoD both internal and external directors whose academic backgrounds reflects a passage through Ivy League universities or other reputable universities in scientific research tends to increase investments in R&D (Dalziel *et al.*, 2011). Furthermore, directors with advanced education would acquire distinctive abilities such as a greater ability to process information, which could positively affect R&D spending (Chen, 2014).

Directors' education would also be a particularly important attribute in the context of intense competition for innovation (Chen, 2014). Thus, each directors' academic background can be considered as a critical resource for organizations and a diversity in the fields of study becomes even more important given that resources should not be chosen and allocated randomly (Jaskyte, 2012). Indeed, leaders must develop strategic resources (Huse, 2005) and bear in mind that their value depends on the context and the urgency of their need (Pfeffer & Salancik, 1978). This process, which can be particularly complex, would certainly benefit from being led by people with different academic backgrounds. Thus, heterogeneity in terms of knowledge among the BoD, more precisely in the fields of study, could be very useful for innovation performance. RDT's assertion that different types of directors would provide different beneficial resources for the firm (Hillman *et al.*, 2000) supports this position.

Overall, it seems that the unique academic background of each director, and more specifically the combination of these backgrounds, is a factor that could have a considerable impact on innovation performance. However, it must be pointed out that the relevance of a diversity in terms of the fields of study does not only refer to the learning of directors in an academic setting. Indeed, the educational background also allows for opportunities to make personal connections and to sharpen interpersonal skills. Each director could therefore contribute to innovation performance, not only through the academic notions acquired in the classroom, but also by making its organization benefit from its network and other competences such as its soft skills. This is particularly relevant given that these skills can drive innovative behaviour, and that even if they are called "soft", they are not easy to acquire (Chell & Athayde, 2011). Also, "soft skills", or what others call "emotional intelligence", refers to innate abilities, which make them more complex than "more common skills" (Pant & Baroudi, 2007). Moreover, given that firms should have access to complementary resources for R&D investments to become truly productive (Teece, 1986), we can assume that knowledge diversity within the BoD represents one of these complementary resources. Supporting this position, Hillman and Dalziel (2003) pointed out that RDT provides the tools to investigate on several characteristics of directors, including their knowledge, which many studies have been able to link to a better ability of the BoD to advise their organizations. Based on these arguments, we can anticipate that:

H2a: Educational diversity in terms of the fields of study is positively related to innovation performance.

Educational diversity, as it was the case of functional diversity, can be approached from two perspectives, more precisely through the fields and levels of study (Heyden *et al.*, 2015). The latter can be interesting as the content, method and context may differ significantly from one level to another. For example, undergraduate studies do not focus much on research and could bring a more pragmatic view gained from a "field experience" that is sometimes lacking for those who are more focused on scientific research. In addition, students are generally much more numerous in undergraduate classes, whereas this number decreases as the level of study increases. On their part, directors having completed master's degrees with a research profile and PhDs would bring some prestige and increase the legitimacy of the organization given their expertise in their respective fields. Also, even if the network potential might be smaller at this level, it is however more valuable as it could be composed of people with more distinctive knowledge and skills.

The study of diversity in the levels of study at the board level is still an underrepresented topic in the scientific research but has already yielded interesting and sometimes mixed results. For example, undergraduate studies have been positively associated with firm performance (Boadi *et al.*, 2019) while it has been found that the presence of higher educational levels in the BoD can also have a positive impact on firms' performance and strategy (Ujunwa, 2012; Wiersema & Bantel, 1992).

As to the effect of directors' diversity in the levels of study on innovation, Midavaine *et al.* (2016) found a positive and significant relationship. On a similar position, it has been argued that directors' demographic diversity would encourage innovation mainly because it would help to attract a pool of individuals with diverse knowledge and perspectives (Zona *et al.*, 2013). In sum, the combination of directors having different levels of

study would allow the organization to benefit from different ways of doing and thinking, which could lead to an increase in innovation performance. This assertion is supported by the fact that strategic discussions involving innovation require various approaches and diverse perspectives to enrich their content and foster their potential (Auh et Menguc, 2005; Pfeffer et Salancik, 1978). In this sense, the present discussion prompts us to postulate that:

H_{2b}: BoD educational diversity in terms of the levels of study is positively related to firm innovation performance.

3. Methodology

3.1 Sample and Data Sources

The sample includes 97 firms that are ranked among the 100 most innovative companies in the world by Forbes magazine in 2017 for a total of 1027 directors. A similar approach has been used by past studies. For example, Robeson and O'Connor (2013) have selected their sample from the Fortune 1000 most admired firms. We manually collected our data using several sources, such as annual reports, Boardex database, Morningstar and Bloomberg. When we were not able to collect the relevant data, we managed to directly contact the companies. The use of different sources to obtain our data enabled us to only exclude three of the 100 firms for missing data. At this stage, it should also be noted that as suggested by Torchia et al. (2011, 2015), board members who do not have the right to vote (e.g., emeritus directors) are not included in our analysis.

As an alternative ranking on innovation performance to the one established by Business Week between 2005 and 2009, Forbes' ranking was created on the release of the Dyer and Gregersen, 2011 book "*The Innovator's DNA*", and continues to be published each year. It is based on various financial indicators and expectations of future innovations. This ranking is one of the few that showcase the most innovative companies in the world. The closest one is the 50 most innovative firms' ranking produced annually by the Boston Consulting Group. However, the criticism of BusinessWeek's ranking stating that it is mostly a popularity contest also applies to the latter. Indeed, the measure with the highest weight (80%) for this ranking is based on the vote of executives. Therefore, it is mainly based on opinions, which is a much more subjective aspect than financial indicators. On its part, Forbes' ranking is based on a more elaborate tool: the innovation premium. We will discuss it in more detail in the presentation of our dependent variable.

3.2 Independent Variables

Diversity in the fields of expertise: A double dimension characterizes functional diversity because it groups together two underlying variables. First, the goal is to test the diversity in terms of the fields of expertise. At this level, there are ten categories: (1) Management, (2) Marketing, (3) Finance, (4) Accounting (5) Operations Management (6) Human Resources, (7) Legal, (8) Computer Science, (9) Engineering and (10) Health. In a similar approach to that of several authors (e.g., Heyden et al., 2015, Erhardt et al., 2003, Haynes and Hillman, 2010, Kim and Kim, 2015), we have adapted the categorization to our sample by defining and redefining the categories as data collection progressed. Following the approach advocated by previous studies (e.g., Wincent et al., 2014), the Blau Index is used to measure this characteristic.

Diversity in the sectors of expertise: Functional diversity is also tested through the diversity in the sectors of expertise, that is the one in which each director has worked the most during his professional career. The relevance of this variable has been demonstrated by establishing its relevance regarding various organizational outcome such as internationalization (Barrosso et al., 2011) and can also be relevant to explain innovation performance. At this level, we have eight possibilities: (1) Technology, (2) Banking (3) Public, (4) Art and Entertainment, (5) Consulting, (6) Health, (7) Durable Goods and (8) Non-durable goods. This characteristic is also measured by the Blau Index.

Diversity in the fields of study: In terms of educational diversity, which concerns the academic background of directors, we also have two dimensions. The first is the diversity in the fields of study and was conceived around the following categories: (1) Business Administration, (2) Finance, Accounting and Economics, (3) Computer Science and Technology, (4) Engineering, (4) Life Sciences and environment, (6) Science of matter, (7) Law and (8) Arts/Communication. Note that for each director, it is the highest completed diploma that was considered. We have also used the Blau Index to measure this type of diversity.

Diversity in the levels of study: Midavaine et al. (2016) have considered four categories to measure the diversity in the levels of study, that is, bachelor's, master's, MBA and Ph.D. We opt for three categories that accounts with the different cycles of study: undergraduate, postgraduate (master level) and doctoral. It is the highest level of study achieved that has been considered and the Blau Index that has been used to measure this variable. Table 1

summarizes the set of independent variables.

Table 1. Summary of independent variables

Variable	H	Symbol	Measure
Diversity in the fields of expertise	H1a	Blau_Fld_Exp	Blau index ($1-\sum p_i^2$) including ten categories.
Diversity in the sectors of expertise	H1b	Blau_Sct_Exp	Blau index ($1-\sum p_i^2$) including eight categories.
Diversity in the fields of study	H2a	Blau_Fld_Std	Blau index ($1-\sum p_i^2$) including eight categories.
Diversity in the levels of study	H2b	Blau_Lvl_Std	Blau index ($1-\sum p_i^2$) including three categories.

3.3 Control Variables

This study has mobilized various control variables to consider potential BoD effects (*BoD independence and BoD size*). BoD independence has often been calculated by the proportion of external directors (Boone et al., 2007, Zhang et al., 2007, Liao et al., 2015), however, some authors have rather used a binary variable by suggesting that it would be interesting to distinguish between a mainly independent board and a mainly dependent board (e.g., Anderson et al., 2004; Faleye et al., 2011). We used the latter approach by coding 1 if the board is mainly comprised (more than 50%) of independent directors and 0 otherwise. BoD size has recently been in high demand for control purposes by studies that have focused on the BoD (e.g., Balsmeier et al., 2017, Heyden et al., 2015, Miller & Triana, 2009) so in line with this observation, it is also included in our models.

We also control for potential organizational effects (*Firm size, sector, and region*). Following various authors, we have used the natural logarithm of the total number of employees to measure Firm size (e.g., Galia & Zenou, 2012, Miller et Triana, 2009; Torchia et al., 2011, 2015, Zona et al., 2013). Also, given the relevance of controlling for eventual sectorial effects (Arthurs et al., 2008; Dalziel et al., 2011; Johnson et al., 1996; Kor, 2006) we split the sample into five main sectors: (1) Computer, electronical and semi-conductorial firms, (2) Pharmaceutical and biotechnological firms (sector of reference), (3) Consumer goods firms, (4) Manufactural firms and (5) Service firms. Regarding the geographical context, that is also an important element when studying the potential impact of corporate governance on performance (Daziel et al., 2011; Huse, 2000), there are three options: (1) America (region of reference), (2) Europe and (3) Asia. All control variables are resumed in table 2.

Table 2. Summary of control variables

Variable	Symbol	Measure
Independence of the BoD	IND	Firms with a BoD that is considered as independent (more than 50% of external directors).
Size of the BoD	BoD_Sz	Total number of directors
Size of the firm	Firm_Sz	Natural log of total employees
Sector	IT_Elec_SM	Computer, electronical and semi-conductorial firms.
	Pharm_Biotech	Pharmaceutical and biotechnological firms
	CG	Consumer goods firms
	MNF	Manufactural firms
	SRV	Service firms
Region	AM	America
	EU	Europe
	AS	Asia

3.4 Dependent Variable

We have used the innovation premium as a dependent variable. It is based on an algorithm of the Credit Suisse (Holt) and results from the difference between firm market capitalization and the net present value of cash flows (Forbes, 2017). This variable considers various criteria supporting the rigour of its conception. For example, only companies with at least seven years of financial statements and with a market capitalization of at least \$ 10 billion are considered. To our knowledge, there is no other studies that has yet considered this measure as an indicator of innovation performance, while other conventional indicators such as R&D spending (Aboody & Lev, 2000; Kor, 2006; Zona et al., 2013) or the number of patents (Brem et al., 2016; Katila, 2000; Xie and O'Neill, 2013) have been the subject of much criticism. Hence, and as Kor (2006) pointed out, we believe that the intensity of R&D investments is a source of innovation and not an innovation *per se*. In line with this argument,

while R&D investments reflect the efforts made to innovate (Miller & Triana, 2009), we insist on the fact that they should not be confused with the output of these efforts, that is, innovation. On a similar position, the Oslo Manual (2018) points out, "innovation goes far beyond R&D". These elements suggest that a company could invest billions of dollars in R&D without ever innovating. In addition, Zahra (1996) were very critical of the use of the two most common innovation indicators (R&D expenditures and patent). In particular, this author has claimed that R&D spending could reflect high agency costs and that they do not necessarily guarantee product or process innovations. Regarding the number of patents, Zahra (1996) has argued that it would not always be possible to assess their financial viability. Furthermore, the preconception that innovation is mostly about introducing a completely new product is fueled by much of the literature that has used this specific measure (Gao et al., 2017, Katila & Ajuha, 2002; Li & Zajac, 2018). However, consistent with the definition of the Oslo Manual, innovation can take various forms. Another indicator that has gained popularity in recent years is the use of surveys such as the Community Innovation Survey (CIS) (Allemand et al., 2017; Galia & Zenou, 2012; Laursen & Salter, 2006). While this tool is interesting, it seems difficult to establish credible links between directors' characteristics and the fact that at a given moment, an organization would have declared a specific type of innovation. Indeed, because of a combination of factors, a company could have innovated during the period considered by the survey (generally two or three years) without its history showing any other sign of innovation in several years with practically the same board members. A chance effect could then exist. Is a firm that has not innovated for many years and has finally declared an innovation for the first time during the period covered by the survey truly innovative because of its BoD? Are there any audits to validate the innovations reported by the companies that respond to the survey? These questions are worth asking. In this sense, and without contesting the use R&D investments, patents or surveys, we humbly consider that novel measures should be tested to complement these more traditional innovation measures, especially given the redundancy in the choices as well as the many criticisms towards the latter.

4. Results and Discussion

4.1 Descriptive Statistics

In terms of sector representation, Table 3 shows that five main industries are represented in our final sample. When we combine the first two categories, and given that the ranking includes the world's most innovative firms, we logically observe that the high-tech sector accounts for almost half of all firms. Also, unsurprisingly, the service industry is the less resented in our sample, which can partially be explained by its "traditional low-tech environment" (Hertog et al., 2011).

Table 3. Sectorial breakdown of the final sample

Sector	#	%
IT_Elec_SM	24	24,70
Pharm_Biotech	20	20,60
CG	21	21,60
SRV	15	15,50
MNF	17	17,50
Total	97	100

Regarding the geographical distribution, Table 4 shows that three continents are represented. America alone accounts for more than half of the companies (55.60%), more than twice as much as Europe (22.70%) and Asia (21.70%). An overwhelming majority of American-based firms are based in the United States (51 out of 54). The other three have their headquarters in Canada, Chile, and Brazil. These results support the fact that the United States have often stay ahead of the curve regarding innovation. Also, while Latin-America is represented by two countries, we notice that no country represents the African continent.

Table 4. Geographical representation of the final sample

Region	#	%
America (AM)	53	55,60
Europe (EU)	22	22,70
Asia (AS)	21	21,70
Total	97	100

The descriptive statistics of the seven numerical variables (representing the four independent variables and three of the five control variables) are presented in table 5. The results show an important diversity in terms of fields of expertise, sectors of expertise and fields of study. The heterogeneity regarding the levels of study is less pronounced, which is logical given that it includes only three categories, where the other three independent variables include at least eight categories. We also notice a high representation of independent directors and important variations in terms of size, both at the board and firm levels.

Table 5. Summary of the descriptive statistics

Variable	Minimum	Maximum	Mean	Std-Dev	Median
Blau_Fld_Exp	0	0,8600	0,6689	0,1294	0,6914
Blau_Sct_Exp	0	0,8469	0,6189	0,1674	0,6446
Blau_Fld_Std	0,1653	0,8284	0,6411	0,1254	0,6667
Blau_Lvl_Std	0	0,7400	0,5139	0,1269	0,5400
IND	0%	100%	68,36 %	23,85 %	77,78 %
BoD_Sz	5	15	11	2	10
Firm_Sz	205	527180	43572	8267	13 539

Our models include some categorical variables (i.e., sector and region of the organization), so we chose to conduct a Spearman's correlation test instead of a Pearson's correlation test as it is more suitable in this case. The correlation matrix is shown in Table 6. It notably reveals a negative and significant correlation between innovation performance and the following variables: functional diversity in terms of the sectors of expertise, board size, firm size and European firms. In contrast, there is a positive and significant correlation between Asian firms and innovation performance. Another fact that must be pointed out is that there is no correlation higher than 0,70, which attests of the absence of multicollinearity.

Table 6. Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	1															
2	0,003	1														
3	-0,23**	0,01	1													
4	0,18	-0,08	0,16	1												
5	-0,03	0,03	0,200	0,37**	1											
6	0,12	0,09	0,18	0,09	0,11	1										
7	-0,20*	0,06	0,31**	0,02	0,12	-0,08	1									
8	-0,39**	-0,27**	0,39**	0,03	0,09	0,00	0,27**	1								
9	0,04	0,02	0,16	-0,01	-0,07	0,47**	0,02	-0,08	1							
10	-0,29*	0,08	0,12	0,00	0,13	-0,19	0,13	0,27**	-0,61**	1						
11	0,25*	-0,06	-0,31**	0,01	-0,04	-0,38**	0,16	-0,18	-0,59**	-0,29**	1					
12	0,15	0,03	-0,32**	0,13	-0,14	-0,04	-0,21**	-0,17	-0,02	-0,14	0,16	1				
13	0,15	-0,04	0,07	0,11	0,23*	0,13	-0,14	-0,28**	-0,15	0,03	-0,14	-0,29**	1			
14	-0,08	-0,03	0,08	-0,02	0,05	-0,03	0,28**	0,17	0,02	-0,05	0,03	-0,30**	-0,27**	1		
15	-0,15	-0,02	0,13	-0,17	0,20	-0,06	0,10	0,14	-0,02	0,11	-0,09	-0,25*	-0,22**	-0,23*	1	
16	-0,09	-0,02	0,09	-0,07	0,04	-0,10	-0,02	0,16	-0,13	0,14	0,02	-0,26**	-0,24*	-0,24*	-0,20	1

Significance (two-tailed): * p < 0,05 ; ** p < 0,01.

Dependent variable: 1. Innovation premium

Independent variables: 2. Blau_Fld_Exp ; 3. Blau_Sct_Exp ; 4. Blau_Fld_Std ; 5. Blau_Lvl_Std.

Control variables: 6. IND ; 7. BoD_Sz ; 8 Firm_Sz ; 9. AM ; 10. EU ; 11. AS ; 12. IT_Elec_SM ; 13. Pharm_Biotech ; 14. CG ; 15. SRV ; 16. MNF

4.2 Statistical Models' Validation

In total, five models were tested as shown in table 7. The first only includes control variables. Each of the subsequent models (models 2 to 5) tests the explanatory variables by adding them one at a time while considering all control variables. Because the models include categorical variables with more than two options (for the region and sector), one region and one sector are voluntarily missing from the models as they represent our reference variables. Thus, *America* ("AM") is considered as a reference variable for the region, while we have retained the variable that groups together the pharmaceutical and biotechnology industries ("Pharm_Biotech") as the reference one for the sector. These choices are justified by the fact that this continent and these two sectors are particularly known for their innovative culture.

Table 7 also illustrates that all models were significant at the 1% threshold. The values obtained for "F", "R2" and "adjusted R2" demonstrate in turn that each model, through the variables that compose it, is a good predictor of the variation of firms' innovation performance. The null hypothesis according to which there is no relationship between our independent variables (related to the BoD) and our dependent variable (related to innovation performance) is therefore rejected for all models, which allows us to go further in the analysis.

At this stage, it seems important to mention that all conditions have been met to drive our regressions. Indeed, the premises related to normality (95% of the standardised residuals are included in the interval [-2; +2], heteroscedasticity (a Levene test for the variable « standardised residuals » was nonsignificant), linearity (the « P-P plot » of the standardised residuals showed that the points on the graph tend to converge towards the straight line), autocorrelation (the Durbin Watson value of all models is between 1.5 et 2.5) and multicollinearity (Variation Inflation Factor smaller than 10 for all variables) have all been respected. Thus, all our measures have been validated and did not required any adjustments.

4.3 Hypotheses Testing

The multiple linear regression revealed that functional diversity in terms of the fields of expertise is not positively related to innovation performance. Thus, more than twenty years after the unsuccessful attempt by Daellenbach et al. (1999) to link this type of diversity to innovation, we too do not achieve conclusive results. Hypothesis H_{1a} is therefore rejected. In this sense, our results contradict those of several studies that have demonstrated its positive impact on various organizational outcomes (e.g., Bantel & Jackson, 1989; Bear et al., 2010; Daveri & Parisi, 2015; Dou et al., 2015; Heyden et al., 2015; Hoffman & Hegarty, 1993; Kor, 2006; Lyon & Ferrier, 2002; Talke et al., 2010; Van der Vegt & Janssen, 2003; Wincent et al., 2010). One explanation is that diversity in the fields of expertise could be beneficial at some stages and rather harmful at others. For example, it could be beneficial at the stage of ideas' development and become problematic at the implementation stage (Quian et al., 2013). Thus, it could globally result in neutralizing the positive effects of this characteristic on innovation performance.

Nevertheless, and as expected, our findings support our assertion regarding the negative impact of directors' diversity in terms of the sectors of expertise on innovation performance ($p < 0.10$). This result is consistent in all the models. Hypothesis H_{1b} is therefore supported, which is coherent with the postulate of RDT. Indeed, it confirms the validity of the argument stipulating that a strong heterogeneity at this level would imply that many directors would not have a good enough knowledge of the industry in which their current organization operates, which could represent a serious "handicap" for innovation purposes. In this continuity, it would imply that many directors would need a certain time to properly understand the mechanisms specific to their organization's sector. As a result, they would not be able to influence innovation performance, at least in the short and medium term.

The results also highlight the relevance of BoD' educational diversity by revealing a positive and significant relationship between diversity in the fields of study and innovation performance ($p < 0.10$). This finding is consistent for all models and reinforces the observation of Hillman et al. (2000) in asserting that different types of directors may provide various beneficial resources to their firm. Thus, hypothesis H_{2a} is supported which is also in line with the argument stipulating that the plurality of directors' knowledge in terms of the fields of study would make the organization more able to acquire strategic resources, such as those needed to innovate. Overall, our results reinforce the relevance of BoD's academic background (Dalziel et al., 2011; Hillman et al., 2000; Hillman & Dalziel, 2003; Mahadeo et al., 2012; Zona et al., 2013). Moreover, it confirms those of previous studies having concluded that knowledge diversity could foster innovation and improve the ability of the BoD to provide better advice (Chen, 2014, Dalziel et al., 2011, Midavaine et al., 2016, Zona et al., 2013). Likewise, this suggests that BoD' diversity in the fields of study could be one of what Teece (1986) termed as "the complementary resources enabling R&D investments to be productive". In this sense, knowledge that springs from board members' educational diversity can indeed be considered as a key resource and could potentially lead

to an increase in innovation and the acquisition of a competitive advantage (Erhardt et al., 2003; Kor & Sundaramurthy, 2009; Zahra & Pierce, 1989).

As for the level of study, our results have not revealed a significant effect as to its impact on innovation performance, unlike Midavaine et al. (2016) who were able to confirm its positive influence on R&D expenditures. In this sense, Hypothesis H_{2b} is rejected, which is rather in line with the study of Heyden et al. (2015) that has also not been able to yield significant results regarding this aspect. In this sense, it might be more relevant to focus on the effect of each level of study rather than the diversity in the levels of study as it has produced more conclusive findings (e.g., Boadi et Osarfo, 2019; Ujunwa, 2012; Wiersema & Bantel, 1992).

In sum, the results of our hypotheses testing suggest that the most critical element regarding innovation performance when it comes to functional diversity within the BoD is to maintain a high degree of homogeneity in the sectors of expertise, which can be a way to prevent from having too many directors that do not have a good knowledge of their current firms' industry specificities. As for educational diversity, what seems to be the most crucial so that the BoD can enhance its firm's innovation performance is to have directors who have acquired a diversity of knowledge in terms of the fields study and not necessarily in terms of levels of study.

In addition, we also note that various control variables have significant effects on innovation performance. First, having a majority of the BoD made up of independent directors (more than 50% of its members) is positively related to innovation performance. This finding is consistent previous studies (Balsmeier et al., 2014; Balsmeier et al., 2017; Gani & Jermias, 2006). In this sense, it supports the idea that greater BoD' independence would enable directors to make better decisions in complex and uncertain strategic activities, such as those related to R&D and innovation (Balsmeier et al., 2014). Similarly, this result supports the contention of Johnson et al. (1996) that this type of director would be the one who assumes the role of resource dependence. This result is also consistent with RDT, which discusses three main reasons justifying the appointment of independent directors. The first is the possibility of hiring people with managerial skills that the organization will benefit from (Pfeffer & Salancik, 2003 p. 161). The second refers to the support that independent directors can provide by being mindful of the problems their organization can face and helping it resolve them (Pfeffer & Salancik, 2003, p.162). The third reason is related to their ability to manage and control (Pfeffer & Salancik, 2003, p.162).

As for the size of the firm, our regressions have revealed that the more it increases, the more the innovation performance of the organization decreases. This observation reinforces the studies concluding that smaller firms are more innovative (Chandy & Tellis, 2000, Cohen & Klepper, 1996, Holmstrom, 1989). On the other hand, it contradicts those who have argued that it is rather large firms that are the most innovative (e.g., Camisón-Zornoza et al., 2004; Damanpour, 1992, Miller & Triana, 2009). All in all, although the study of the link between organizational size and innovation has produced no consensus (Zona et al., 2013), our results rather support the benefits associated with the simplicity of small firms through their task organization, their different attitude towards risk and their collaboration with organizations that can provide them with resources they do not have (Chandy & Tellis, 2000, Holmstrom, 1989). Our finding regarding firm size is also consistent with the RDT's assumption stating that it should be aligned with the organization's needs in terms of resources and links to allow it to be less dependent of the external environment (Pfeffer & Salancik, 1978). In other words, it supports the idea that a larger size is not necessarily a guarantee of positive organizational outcomes.

An additional rather counterintuitive result is that Asian firms seems to perform better regarding innovation than American firms. The rapid growth of the economies of Asian countries in recent decades may partly explain this result. Conversely, a rather intuitive result is that firms in the service industry are less successful in innovation performance than those in the pharmaceutical and biotechnology industry. The culture of innovation inherent to these last two sectors is certainly no stranger to this finding. Also, it confirms, as we pointed out earlier, that the service industry is traditionally known as a "low tech environment".

Finally, it is fundamental to consider potential endogeneity problems when studying corporate governance, especially when the goal is to link the BoD to firm performance (Wintoki et al., 2012). The main problems arise from potentially omitted variables and reverse causality (Adams et al., 2015; Adams & Ferreira, 2009; Lu & Wang, 2018). We partially address the first concern by using various control variables at the BoD and organizational levels. The significance of the results regarding the independent variables remained unchanged with or without the control variables. Regarding reserve causality, it suggests that the most performing firms in innovation could have chosen to opt for an heterogenous BoD. Thus, it implies that it might not be diverse boards that enhance the innovation performance of their organizations, but rather innovative organizations that have diverse boards. We have also partially tackled this problem by regressing the dependent variable on all the independent and control variables. The results reveal nonsignificant relationships. Thus, it proves that the causal

effects go from the board and organizational characteristics to innovation performance, not the opposite. In line with several studies, we have also used a lagging period (one year) between the independent variables and the dependent variable (Bravo & Reguera-Alvarado, 2017; Carter et al., 2010; Ntim, 2015; Reguera-Alvarado & Bravo, 2017; Yermack, 1996), given that BoD' influence on performance is a process that takes time (Carter et al., 2010). These three procedures used to account for potential endogeneity issues (inclusion of control variables at the board and organizational levels to diminish the risk of omitting variables, the test of reverse causality and the use of a lagging period) combined with the different validation tests of our measures support the robustness of the findings presented in table 7. We acknowledge that other most sophisticated procedures to address potential endogeneity issues such as the use of instrumental variables and two-stage least square regressions would be beneficial. However, our approach in considering potential endogeneity issues is not only in line with several studies as underlined earlier, but goes further than a lot of papers published in the field of strategic management (Hamilton & Nickerson, 2003) and more specifically in corporate governance (Wintoki et al., 2012).

Table 7. Results of multiple linear regression

Variable	Model	1	2	3	4	5
Blau_Fld_Exp			0,036	0,041	0,047	0,046
Blau_Sct_Exp				-0,089*	-0,114*	-0,124**
Blau_Fld_Std					0,095*	0,119*
Blau_Lvl_Std						-0,019
IND		0,050**	0,051**	0,054**	0,043**	0,046**
BoD_Sz		-0,001	0,004	0,006	0,002	-0,003
Firm_Sz		-0,014**	-0,014**	-0,009*	-0,007*	-0,009*
EU		-0,032	-0,031	-0,025	-0,028	-0,032
AS		0,053**	0,062**	0,053**	0,048**	0,052**
IT_Elec_SM		0,004	0,005	0,003	0,007	0,006
CG		-0,018	-0,031	-0,028	-0,032	-0,030
SRV		-0,042*	-0,057*	-0,058*	-0,051*	-0,049*
MNF		-0,014	-0,019	-0,020	-0,019	-0,016
R2		0,229	0,269	0,278	0,294	0,298
Adjusted R2		0,149	0,153	0,157	0,163	0,155
F		2,732***	2,318***	2,297***	2,236***	2,383***

Significance : * p < 0,10 ; ** p < 0,05 ; *** p < 0,01.

5. Conclusion

The aim of this study was to explore the potential impact of BoD' deep-visible diversity, measured by functional and educational diversity, on innovation performance. Our analysis was based on a unique and hand collected database designed around an international sample of 97 firms for a total of 1027 directors. Ultimately, it has revealed that directors' diversity both in terms of functional and educational background is relevant to explain firms' innovation performance. Indeed, the results have more precisely shown that BoD' functional diversity in terms of the sectors of expertise as a negative and significant effect on innovation performance. On the opposite, BoD' educational diversity in terms of the fields of study had a positive and significant effect on innovation performance.

These results contribute to enrich the literature at various levels. First, our analytical framework distinguishes itself from the ones mobilized by previous studies on this topic as it includes two different variables to measure both functional (for fields and sectors of expertise) and educational (for fields and levels) diversity. This initiative makes it possible to consider different levels of a single type of diversity. We have also used a novel measure to compute innovation performance: the innovation premium. Thus, we have addressed a major limit identified by past studies which is the presence of an important homogeneity in the selection and measure of both independent and dependent variables (Midavaine et al., 2016). Also, and still at the methodological level, this study provides another empirical contribution by relying on an international sample unlike most of corporate governance research that tends to present results that are based, and thus might only be valid, in a specific geographical context (Boyd et al., 2017).

Our approach allows us to go further than the traditional control/surveillance role attributed to directors by supporting that their decision-making process and strategic orientation (Carpenter & Westphal, 2001, Goodstein

et al., 1994, Haynes & Hillman, 2010, Pearce and Zahra 1992, Walt and Ingley 2003, Zahra & Pearce 1990) represent key aspects on which firms can rely to improve their innovation performance. An additional contribution lies in our theoretical foundations. Indeed, given that the postulate of agency theory has repeatedly proven to be of little value in studying the relationship between the BoD and various organizational outcomes (Adams et Ferreira, 2009; Carter et al., 2003; Kor, 2006), the choice to draw upon resource dependence theory was appropriate, especially because the latter has allowed a certain consensus as to its relevance in the analysis of BoD potential impact on corporate performance (Hillman & Dlaziel, 2003, Kim, 2015).

Finally, our work shows that the internal (mainly through firm size) and external (through firms' sector and region) environments in which organizations evolve are essential when it comes to innovation performance. In this sense, it highlights the fact that the BoD is certainly important when the goal is to increase innovation performance, but that contextual elements must not be overlooked. This suggests that the impact of BoD characteristics on organizational outcomes cannot be totally understood without looking outside the boardroom by also considering contingencies.

For managers and policy makers, this paper highlights the need to have a heterogeneous board at the educational level, precisely in terms of fields of study. On the opposite, firms should maintain a high degree of homogeneity at the functional level for BoD regarding directors' sectors of expertise to avoid having too many directors that are not enough familiar with their current firms' focal industry. These recommendations can be particularly useful for SME that wants to introduce a BoD, and for larger firms that might already have one, it could guide their board members' recruitment and renewal processes.

In this continuity, our results encourage policy makers and organizations to direct their attention towards a rather cognitive than ethical approach to diversity by focusing on deep-visible diversity instead of surface-level diversity. This initiative could even help to foster the latter, as it will give clear and rational criteria to constitute BoD' composition, which could help increasing the representation of minorities (e.g., women and ethnically diverse members) on boards. Furthermore, when the goal is to enhance their innovation performance, firms should favour a mainly independent board (more than 50% of independent members), take full stock of the benefits of staying small (in terms of total number of employees) and be aware of the considerable influence that their sectorial and geographical contexts can have.

Despite these contributions, and as any scientific contribution, our work has several limitations. First, using a new measure of innovation performance is certainly a guarantee of originality, but can be challenged as many other measures are available. However, knowing that there is no consensus when it comes to measuring innovation performance, we believe that this approach is as legitimate as the ones using R&D expenditures or number of patents, among others. In this continuity, we strongly encourage other researchers to test new measures to eventually move towards a greater consensus for measuring innovation performance. Also, the sample choice and the fact that it considers firms at a given point of time (year 2017) represent major barriers to claim for any generalization, even if these choices are in line with most corporate governance studies. Indeed, it doesn't allow to consider the possible fluctuation of the impact of BoD' functional and educational diversity on innovation performance over time. A longitudinal study based on a larger sample would therefore be of great value, even if we acknowledge that constituting a hand collected database for this purpose would be challenging. Also, as mentioned previously, the context seems to be of paramount importance to innovate. This suggests that the link between the BoD and innovation performance could be mediated or moderated by other factors, such as those related to firms' environment. In this sense, upcoming articles in this field of research should include concepts that account for potential contextual effects. Another limitation of this study is the fact that we do not consider TMT in our analysis. However, the various stakes related to the interactions between the BoD and TMT induce the necessity of considering members of TMT, especially when studying organizational outcomes such as innovation performance. Thus, future research would benefit from looking into these more complex relationships (i.e., impact of the interactions between the TMT and the BoD on innovation performance) to provide a more substantial understanding of the link between corporate governance and innovation. Finally, given that most papers analyzing the impact of BoD on innovation are based on a quantitative approach, to this date, we still know very little on how directors concretely have an impact on their firms' innovation performance. Indeed, the use of statistical methods does not allow to provide rich explanations as to the causal effects that are identified. Recent studies have acknowledged this issue (e.g., Klarner et al., 2019) but there is still a lot of contributions' potential at this level for scholars that want to seize this opportunity.

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