Knowledge management in boards of directors: effects of informational faultlines

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Abstract

Purpose – *The purpose of this study is to examine how informational faultlines on a board affect the management of knowledge owned by directors and the consequences on organizational performance. In this study, informational faultlines are defined as hypothetical lines that divide a group into relatively homogeneous subgroups based on the alignment of several informational attributes among board members.*

Design/methodology/approach – *The study uses unique hand-collected panel data covering 7,247 board members at 106 publicly traded firms to provide strong support for the hypothesized U-shaped relationship. The authors use a fixed effects approach and a system generalized method of moments approach to test the hypothesis.*

Findings – *The study finds that the relationship between informational faultlines on a board and organizational performance is U shaped, with the least optimal organizational performance experienced when boards have moderate informational faultlines. More specifically, informational faultlines within boards are negatively related to organizational performance across the weak-to-moderate range of informational faultlines and positively related to organizational performance across the moderate-to-strong range.*

Research limitations/implications – *By explaining the mechanisms through which informational faultlines are related to organizational performance, the authors contribute to the literature in a number of ways. By conceptualizing how the management of knowledge plays an important role in the particular setting of corporate boards, the authors add not only to literature on knowledge management but also to the faultline and corporate governance literature.*

Originality/value – *This study offers a rationale for prior mixed findings by providing an alternative theoretical basis to explain the effect of informational faultlines within boards on organizational performance. To advance the field, the authors build on the concept of knowledge demonstrability to illuminate how informational faultlines affect the management of knowledge within boards, which will translate to organizational performance.*

Keywords *Knowledge management, Knowledge demonstrability, Informational faultlines, Board of directors, Organizational performance, Group dynamics*

Paper type *Research paper*

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1. Introduction

A corporate board's ability to perform their roles of monitoring and resource provision will largely depend on the management of knowledge by board members (Hillman and Dalziel, 2003; Boivie *et al.*, 2016). Indeed, a board is a high-level knowledge-producing decision-making group that often faces nonroutine and complex strategic issues, requiring its members to capitalize on each other's knowledge (Forbes and Milliken, 1999; Payne *et al.*, 2009). However, not all boards achieve their full potential which has led some commentators to even question the added value of boards as strategic decision-making entities (Schepker *et al.*, 2018). Previous research has explored how boards of directors can enhance organizational performance (Bonini *et al.*, 2022; Krause *et al.*, 2013; Delis *et al.*, 2017; Meng and Tian, 2020) and suggests that to achieve optimal performance,

board members should effectively manage their knowledge (Forbes and Milliken, 1999; Klarner *et al.*, 2021). However, while the management of knowledge occurs at the collective level of the board, knowledge itself is owned at the individual level of the board member (Okhuysen and Eisenhardt, 2002). Therefore, to manage directors' knowledge on a collective level, directors need to be capable of accessing and using each other's unique knowledge (Gardner *et al.*, 2012; Faraj and Sproull, 2000).

Most board research has focused on measuring only the *availability* of knowledge, by examining the diversity of directors' demographic attributes. However, we posit that both the availability and the *configuration* of knowledge play a pivotal role in the use of knowledge to improve performance (Gardner *et al.*, 2012). To measure both the availability and configuration of director's attributes, this study uses the concept of "faultlines," introduced by Lau and Murnighan (1998). *Faultlines* are defined as hypothetical lines that divide a group into relatively homogeneous subgroups based on the alignment of several diversity attributes present among individuals, and such subgroups can influence group functioning (Meyer *et al.*, 2014; Thatcher and Patel, 2012). The lines become stronger as more characteristics align themselves in the same way (Lau and Murnighan, 1998). The faultlines concept allows us to gain insights into subtle differences in the configuration of directors' attributes that cannot be discovered by a standard analysis of diversity (Lau and Murnighan, 1998).

Most prior faultline research relies on social identity and social categorization theories (Ashforth and Mael, 1989; Tajfel and Turner, 2004; Hogg and Terry, 2000), and suggests that faultlines are inherently detrimental to group functioning (Kunze and Bruch, 2010; Thatcher *et al.*, 2003). However, faultline research has started to subdivide faultline types into social category and informational faultlines (Bezrukova *et al.*, 2009). These faultlines are both based on multiple attributes, but social category faultlines are grounded in attributes that reflect a social identity (i.e. gender or age), and informational faultlines are based on attributes that reflect job-relevant knowledge (i.e. job tenure or educational experience). In this study, we focus on the latter as managing job-relevant knowledge is crucial for board members when carrying out their board roles (Finkelstein and Mooney, 2003; Forbes and Milliken, 1999). More specifically, we conceptualize informational faultlines as an important determinant of organizational performance because informational faultlines can be linked to the degree of "knowledge demonstrability" (i.e. the extent to which the merits of the knowledge are recognizable; Kane, 2010) and then subsequently impact the board's ability to manage knowledge. The effective management of knowledge has been found to be important for organizational performance in knowledge management literature (Andreeva and Kianto, 2012; Lee *et al.*, 2012).

Within board research, most studies have demonstrated that social category faultlines have negative consequences (e.g. Crucke and Knockaert, 2016; Wu *et al.*, 2021; Vandebeek *et al.*, 2021; Vandebeek *et al.*, 2016), but the rare findings on the effect of informational faultlines are equivocal. Some studies suggest that informational faultlines can have a positive effect on board functioning (e.g. Shin and You, 2022), while others demonstrate a negative effect (e.g. Kaczmarek *et al.*, 2012; Tuggle *et al.*, 2010). These mixed findings have not yet been explained or properly theorized within board research. As informational faultlines are based on knowledge (rather than social identity), we need an alternative theoretical basis to explain the mixed effects of faultlines within the board context.

Accordingly, in this study we build on the concept of knowledge demonstrability to address the research question:

RQ1. How do informational faultlines within the board affect organizational performance?

The mechanisms of informational faultlines are important within boards for three reasons. First, directors depend on each other heavily to perform their board tasks successfully because no sole director can possess all knowledge given the nonroutineness and

complexity of their tasks (Forbes and Milliken, 1999). Second, within every board, "individuals are nested within subgroups that are in turn nested within the broader board as a whole" (Johnson *et al.*, 2013, p. 246), and we must parse these subgroup effects to advance our understanding of board functioning. Third, board members share a superordinate identity: They derive the social dimension of their identity from belonging to a board and wider director community, working toward the common goal of maximizing value creation for shareholders (Huse, 2005; Hillman and Dalziel, 2003). This identification also stems from, and is reinforced by, a fiduciary responsibility under corporate law to act in the best interests of the firm (Heracleous, 1999). Research has shown that such an overarching identity plays an important role in motivating people to share and thoroughly consider knowledge (Kane, 2010), which can help us explain why board members are motivated to transfer knowledge in certain informational faultline settings.

In this study, we use a fixed effects approach and a system generalized method of moments (GMM) approach to test our hypotheses on a unique hand-collected panel data set covering 7,247 board members at 106 publicly traded firms. The aim of this paper is to provide novel evidence and theory on the effect of informational faultlines within boards, by building on the concept of knowledge demonstrability. By explaining the mechanisms through which informational faultlines within boards are related to organizational performance, we contribute to the knowledge management, corporate governance, organizational behaviour and strategic management literatures in a number of ways.

Our study is structured as follows: First, we provide a theoretical background of the research in the following section (2), and then explain the research method used in our study in the next section (3); subsequently, we present our findings (4). In section five, we present a discussion of our findings in the context of previous theory, provide theoretical, practical and policy recommendations and discuss limitations of the study. In the final section (6), we offer a conclusion and elaborate on future research perspectives.

2. Theoretical background and hypothesis development

2.1 Knowledge management in boards of directors

It is widely acknowledged that the mere presence of knowledge within individuals is not sufficient to produce a competitive advantage as groups must also have the ability to manage knowledge (Barney and Clark, 2007; Bollinger and Smith, 2001). To improve organizational outcomes, knowledge held by individuals must spiral up to the group level (Okhuysen and Eisenhardt, 2002). This study extends these insights to analyses of the functioning of corporate boards. Indeed, directors make strategic decisions to influence financial performance, which are ideally based on the evaluation and selection of multiple action alternatives (Rindova, 1999). However, merely possessing information has been found to have less impact on a board's performance than using diverse information effectively (Zhang, 2010). We will argue that, to achieve great organizational performance, boards should be able to effectively manage their knowledge. At the core of such knowledge management is the transfer of knowledge, which depends on the demonstrability of knowledge (Kane, 2010). Knowledge demonstrability can be defined as the extent to which the merits of knowledge are recognizable (Kane, 2010), and can be determined by the following conditions (Laughlin and Ellis, 1986):

- group members share the conceptual systems needed to understand and communicate;
- group members have the information required to tackle the problem;
- group members who lack a solution are capable of recognizing and accepting a suitable solution if it is proposed by another group member; and
- group members who have a suitable solution have the means and desire to communicate it to other group members.

According to Kane (2010, p. 645), "knowledge transfer is expected to occur more often when knowledge is high in demonstrability and when groups share a superordinate social identity." Identification with a superordinate identity motivates people to consider each other's knowledge profoundly enough to discover its merits because people who share an identity that binds them will see the benefit of transferring knowledge more clearly (Kane, 2010). Scholars have argued that board members share such a superordinate identity because they share a feeling of belonging to a board – a highly visible "elite" group – and the wider director community, with a common overarching goal of maximizing value creation for the firm, continually reinforced by a fiduciary responsibility under corporate law to act in the best interests of the company (Lan and Heracleous, 2010; Bainbridge, 2002a; Stout, 2003). This insight helps us to explain why directors are motivated to transfer knowledge in particular faultline settings.

2.2 Knowledge demonstrability and informational faultlines

Boards with *weak informational faultlines* are composed of directors who all either have the same background (i.e. extremely homogeneous) or all have a different background (i.e. extremely heterogeneous). An example of an extremely homogeneous board is a board with only executive directors with the same tenure and education. There is no homogeneous subgroup formation on such a board based on these diversity attributes. In such boards, directors share a similar background and are, therefore, more likely to share a common language and conceptual system (Smith *et al.*, 1994; Wiersema and Bantel, 1992). Gibson and Vermeulen (2003) argue that, in such groups, a common language and understanding increase the group's quality of communication and access to knowledge, thus, enhancing knowledge demonstrability. For instance, directors with an economics background may be more attentive to financial issues and may be able to readily communicate their opinions to directors with a similar background. However, this type of board might have a limited variety of knowledge due to the homogeneity across the group members' types of directorship, education and tenure. The members of such a board all have access to the same type of knowledge; this lack of informational variety will negatively affect knowledge demonstrability. An example of an extreme heterogenous board is a board composed of both executive and nonexecutive directors, where the executive directors share no other attributes (e.g. each executive director has a different education and tenure) and the nonexecutive directors share no other attributes (e.g. each nonexecutive director has a different education and tenure) but each individual executive director on the board shares the same education and tenure with an individual nonexecutive director. In this case, there is no internal subgroup alignment (i.e. "the extent to which members within a particular subgroup are similar to one another on all other relevant attributes"; Shaw, 2004, p. 72) and a very high level of cross-subgroup alignment [i.e. "the extent to which group members belonging to another subgroup (by falling in another category of the same given attribute) share the same category of the other attributes"; Meyer and Glenz, 2013, p. 399]. There is also no homogeneous subgroup formation based on these diversity attributes in this second type of boards, but such boards have an overall increase in the variety of knowledge, which positively affects knowledge demonstrability. In debating about the optimal decision, directors in such a very diverse board are likely to engage in more in-depth discussions (Cronin *et al.*, 2011), and allocate more time to discussion (Tuggle *et al.*, 2010). However, the heterogeneity of the directors' backgrounds makes a shared conceptual system unlikely, which negatively affects knowledge demonstrability (Cronin *et al.*, 2011; Kane, 2010).

Knowledge owned by directors in boards with *moderate informational faultlines* will be less demonstrable because these boards are unlikely to benefit from the abovementioned potential advantages. Furthermore, the components of informational

faultlines (i.e. internal subgroup alignment and cross-subgroup alignment) are only at a moderate level, which may lead to subgroups that are not clear-cut. In boards where knowledge-based subgroups are blurry, group members must spend a great deal of time and effort working with this vagueness (Kaplan, 1979; Hackman and Katz, 2010). Although there might be more knowledge available, board members can find it more difficult to determine where knowledge resides on the board because, for knowledge to be recognized by others, it must be presented effectively and made available to them (Boland and Tenkasi, 1995). In addition, board members will lack the psychological safety that membership in a strong clear-cut knowledge-based subgroup can provide when, for instance, difficult questions need to be asked or opposing viewpoints need to be shared (Edmondson, 1999), which may impact the directors' board participation as a whole (Mayo *et al.*, 2019). Due to this lack of psychological safety and within-subgroup support, we argue that members of boards with moderate informational faultlines may be more inclined to withhold privately held information to avoid social ostracism (Gruenfeld *et al.*, 1996; Agarwal *et al.*, 2022). People are often reluctant to share information (Bollinger and Smith, 2001), and board members in possession of knowledge required to make the right decision can feel less desire to share knowledge with others and this sharing of knowledge is one of the key behavioural components of the processes involved in knowledge transfer (Tangaraja *et al.*, 2016).

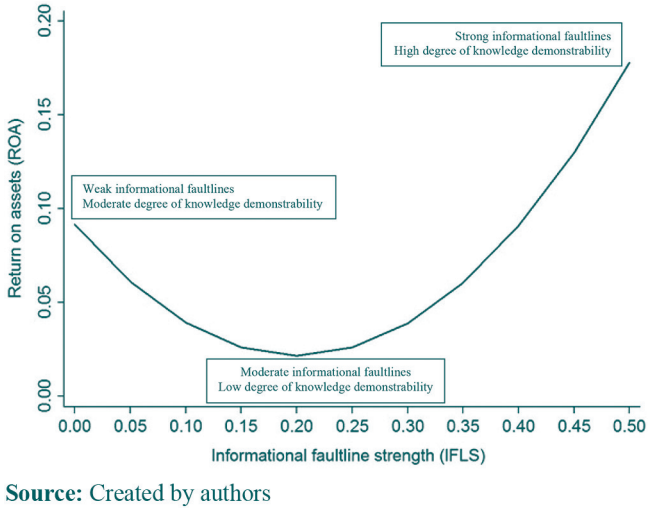
Boards with *strong informational faultlines* on the other hand show higher and more significant levels of subgroup internal alignment (IA) and lower and less cross-subgroup alignment than are seen on boards with moderate informational faultlines (Lau and Murnighan, 1998). For example, consider a board comprising two executive directors having a tenure of more than 10 years and master's degrees in economics and two nonexecutive directors with a tenure of less than 1 year and bachelor's degrees in science-related fields. On this board, there is a strong informational faultline due to the alignment of these four attributes (i.e. type of directorship, tenure, educational specialization and educational level), and two very strong and clearly delineated knowledge-based subgroups are formed. Knowledge demonstrability will be higher on boards with strong informational faultlines than on boards with only moderate informational faultlines because clear-cut knowledge-based subgroups can be positively linked to the four criteria of knowledge demonstrability.

First, directors belonging to a strong knowledge-based subgroup are likely to share a similar conceptual model *within* their subgroup, making it easier to synthesize information with at least some of their fellow directors (Carton and Cummings, 2012). Second, the presence of strong and clearly delineated knowledge-based subgroups can increase knowledge sharing and, thus, available information because it may be more difficult for directors to ignore the existence of these subgroups. Active discussions become necessary for retrieving the relevant information located within these separate subgroups (Bezrukova and Uparna, 2009; Carton and Cummings, 2013). For instance, when executive board members form a knowledge-based subgroup, it becomes crucial that they share internal information with others – such as non-executive board members – as these nonexecutive members would not be able to obtain this information on their own (Finkelstein and Mooney, 2003). If directors share more knowledge, the amount of information that is accessible and available can increase (Bonner and Baumann, 2012; Forbes and Milliken, 1999). Third, directors with access to relevant knowledge are better at persuading others of the value of their own work and recognizing the value of others' work than are group members who have less understanding; therefore, they are more capable of recognizing and accepting the most suited solution (Bonner and Baumann, 2012; Bottger, 1984; Kruger and Dunning, 1999). Similarly, Szulanski (1996) shows that knowledge transfer is highly correlated with the recipients' ability to value newly presented knowledge. To make high-quality decisions, directors should have knowledge about who knows what and must be aware of each other's expertise (Baumann and Bonner, 2004; Van Ginkel and van Knippenberg, 2009). When information becomes strongly linked to knowledge-based subgroups, board members can more easily pool their knowledge, which can make it

more straightforward to locate the presence of knowledge within the board (Cooper *et al.*, 2014; Bezrukova *et al.*, 2009; Nishii and Goncalo, 2008). The information provided is also more likely to be seen as credible when coming from a subgroup than when coming from an individual (Rupert *et al.*, 2016), which can make it easier to see the value of the director's contributions (Bonner and Baumann, 2012; Baumann and Bonner, 2004). For example, the shareholders of a firm facing an environmental lawsuit regarding a particular production process installed several years ago could experience a significant loss in equity value. Ideally, the board contains a strong informational faultline, which creates a knowledge-based subgroup of directors who have both a long tenure (i.e. they were present when the production process was installed) *and* a degree in law. In a board with moderate informational faultlines, knowledge of law and the particular production process is still scattered across different subgroups. Fourth, board members with the most suitable solution must have the means and desire to communicate it to the other board members. A board whose members are more able to make their unique thoughts visible may be better able to manage their knowledge, as their diverse knowledge is fully presented and made available for others (Boland and Tenkasi, 1995). Board members of one strong knowledge-based subgroup or "separate cohort" may feel supported by their subgroup members and feel psychologically safer in sharing their opinions (Edmondson, 1999; Asch, 1952; Gibson and Vermeulen, 2003; Rupert *et al.*, 2016; Peterson and Ferguson, 2014). For example, a nonexecutive director with a short tenure might feel more secure in speaking up when supported by a cohort of other short-tenured non-executive directors. Board members may be more willing to participate in discussions, ask critical questions, engage in and influence key decisions, when they feel supported by their subgroup members and are able to form an alliance based on their similarity with others (Bunderson, 2003). We expect that boards that are better able to manage their knowledge, perform their board roles more effectively. According to management theory, boards that effectively perform their roles are associated with better organizational performance (Bonini *et al.*, 2022; Krause *et al.*, 2013; Forbes and Milliken, 1999; Daily *et al.*, 2003; Dalton *et al.*, 1998; Dalton *et al.*, 1999). Based on the above reasoning, summarized in Figure 1, we predict the following:

H. The relationship between informational faultlines within a board and organizational performance is nonlinear and exhibits a *U*-shaped pattern.

Figure 1 Graphical presentation of curvilinear relationship



Source: Created by authors

3. Methods

3.1 Sample and data collection

Our sample consisted of all Belgian companies listed on the Brussels Stock Exchange (Euronext Brussels) with publicly accessible data of all the observation years (2006–2014). We excluded financial institutions, real estate firms and purely financial holdings because of the underlying differences in their asset structures. The final sample contained unique data on 7,247 board members at 106 publicly traded firms, for a total of 804 firm-year observations. The total number of board members represents the number of board members' data points, and faultlines are calculated for each board. The sample firms account for approximately 71% of the total market capitalization of Euronext Brussels. The Belgian setting is appropriate, because during this time period, these companies operated under a one-tier board system (i.e. both executive and nonexecutive members form one board), and we will use directorship type (e.g. executive, independent or affiliated director) as one of the informational attributes on which faultlines can be based.

We measured our variables on two levels and in two phases. First, we hand-collected individual-level director information from multiple sources. Most information could be found from the annual reports, as publicly listed firms often provide a profile of their directors. When the annual report did not include such a profile, we searched for the information on company websites, press archives and social media (e.g. LinkedIn). In case of missing information, we contacted directors personally to obtain the data. We used the individual data of directors to calculate one faultline strength for each firm in each year. Next, we collected information on the general board and governance variables for each firm-year observation from annual reports. Finally, we collected all accounting and company performance data using the financial Bel-first database of Bureau Van Dijk.

3.2 Measures

3.2.1 Dependent variable. To measure organizational performance, we use a firm's *return on assets* (ROA), which is one of the most used measures of organizational performance (Langan *et al.*, 2022; Richard *et al.*, 2009). ROA is calculated as the operating income before interest and tax (EBIT), divided by the book value of total assets. ROA is particularly appropriate in our context because it reflects the internal workings of the firm rather than the external perceptions of the stock market (Jose *et al.*, 1996). Market-based measures of performance, such as Tobin's Q, reflect growth opportunities (Wintoki *et al.*, 2012) and shareholder expectations (Chung and Luo, 2013) and are very subject to forces that boards cannot control (Hutzschenreuter and Horstkotte, 2013).

3.2.2 Independent variables. The measure of *informational faultlines* is based on a formula proposed by Shaw (2004), which considers how multiple informational characteristics and their alignment may divide a group into knowledge-based subgroups. We apply the most appropriate faultline measure for our research setting following the recommendations of Meyer *et al.* (2014). We used the R statistical software language to run a program designed by Meyer and Glenz (2013) to calculate informational faultlines. Specifically, we measured the extent to which categorical attributes were aligned within, and deviated between subgroups (Shaw, 2004). This method allowed us to assess the extent to which the alignment of individual characteristics divides a group into knowledge-based subgroups.

First, the program calculated the subgroup's IA, which reflected "the extent to which members within a particular subgroup are similar to one another on all other relevant attributes" (Shaw, 2004, p. 72). The IA value ranged from 0.0 to 1.0, with 0.0 indicating no alignment and 1.0 total alignment within a subgroup. Second, cross-subgroup alignment (CGAI) was measured. CGAI assessed the extent to which group members of different knowledge-based subgroups formed by one attribute share the same category of all other

attributes; CGAI ranged from 0.0 to 1.0. Ultimately, the overall faultline measure was calculated as an interaction between IA and the reciprocal of cross-subgroup alignment (1 – CGAI), with informational faultlines ranging between 0.0 and 1.0, where larger values indicated greater strength (Shaw, 2004).

We operationalized informational faultlines along four informational characteristics, which have been defined by prior research as most relevant (e.g. Bezrukova *et al.*, 2009; Hutzschenreuter and Horstkotte, 2013): type of directorship, educational background, level of education and tenure on the board. We limit our attributes to these four, as "the more characteristics are combined in a single faultline measure the more difficult it is to determine whether an observed effect is driven by a combination of all characteristics or just a subset" (Hutzschenreuter and Horstkotte, 2013, p. 719). All these attributes relate to the presence of acquired knowledge and experience, and represent job-related forms of diversity, which are found to have a greater impact on organizational performance (Simons *et al.*, 1999; Milliken and Martins, 1996; van Knippenberg *et al.*, 2004). These attributes also measure group members' know-how and represent their accumulated practical skills and expertise (Gardner *et al.*, 2012). Directorship type is divided into three categories: "executive director," "independent director" and "affiliated director" (i.e. nonexecutive and non-independent). Board members who are executive directors may possess unique "tacit" knowledge related to daily operations and internal management issues, while nonexecutive directors may have access to external networks that can aid in acquiring outside information (Forbes and Milliken, 1999), which can be an important source of unique knowledge (Cummings, 2004). To measure educational background, we categorized directors into four educational areas – sciences, economics, laws and business – representing the discipline in which they received their highest degree. We classified the education of directors who received their degree in another area as "other." Diversity of educational specialization has been found to have strong effects on the range, depth and integration of information use (Dahlin *et al.*, 2005). Board members' educational background is also linked to how they perceive and process information and respond to certain board issues (Milliken and Martins, 1996); it reflects important differences in perception and knowledge that directly influence the board's tasks (Dahlin *et al.*, 2005). We also classified each director into one of four educational levels: high school, professional bachelor's degree, academic master's degree and PhD. Higher levels of education have been found to affect cognitive models and thereby executives' strategic decisions (Hitt and Tyler, 1991). Lastly, we include board tenure as board members who have been on the board for a long time likely possess more job-relevant knowledge and experience (Bainbridge, 2002b). Tenure was assessed by a categorical measure, as required by the faultline program. We followed Kunze and Bruch (2010) and classified the directors into one of four tenure categories: less than 1 year, 1 to 5 years, 6 to 10 years and more than 10 years.

3.2.3 Control variables. At the firm level, we controlled for *firm size*, measured as the natural logarithm of total assets. Smaller firms, for example, may develop change strategies that could facilitate the board's ability to influence organizational performance (Dalton *et al.*, 1998). In addition, we controlled for *firm age*, measured as the natural logarithm of the number of years the firm has existed, as older firms might benefit from more experience and access to more resources (Miller and del Carmen Triana, 2009). To control for differences in *financial structure*, we included firm leverage, measured as total debt divided by total assets. These first three control variables were derived from the Bel-first financial database provided by Bureau Van Dijk. Finally, we completed the dynamic model by including *past organizational performance* using ROA lagged by one year (Wintoki *et al.*, 2012). Including lagged dependent variables in the fixed-effects equation could produce biased estimates (Chung and Luo, 2013; Roberts and Whited, 2013). Therefore, we estimated our main model with and without the lagged ROA, which produced similar results.

At the board level, we controlled for *board size*, measured as the total number of directors on the board. Research has shown that board size has a negative impact on organizational performance (Yermack, 1996; Eisenberg *et al.*, 1998). Furthermore, we controlled for differences in ownership structure in terms of the influence of large blockholders and the CEO, as *CEO ownership* (e.g. the total percentage of shares owned by the CEO) and *block ownership* (e.g. the largest percentage of shares owned by a group or major shareholders) have been shown to affect firm value (Lins, 2003; Griffith, 1999). These four control variables were drawn from annual financial reports. Furthermore, we followed diversity research (e.g. Lau and Murnighan, 2005; Bezrukova *et al.*, 2009; Li and Hambrick, 2005; Cooper *et al.*, 2014) and controlled for *general diversity effects* by calculating Blau's heterogeneity index (Blau, 1977) from our four informational attributes and averaging them to obtain a general board diversity index. Furthermore, we controlled for the effects of *social-category faultlines* based on gender and age attributes. Finally, in our system GMM models, we controlled for *industry effects* by including industry dummy variables because organizational performance may vary across industries due to economies of scale and competitive intensity (McWilliams and Siegel, 2000). We included dummy variables because methods such as using the industry-average ROA as the dependent variable or controlling using the mean ROA have been found to distort inferences and provide inconsistent estimators (Gormley and Matsa, 2013). In our fixed-effects models, we do not include industry dummy variables because industry membership was constant for all firms during the study period (i.e. time-invariant), and fixed-effects models control for constant unmeasured differences across firms that may explain differences in the dependent variables (Greene, 2007). Finally, the effects of time period differences were controlled by including *year dummies* in every model. In this way, we controlled for potential biasing effects due to the global financial and economic crisis of 2008.

3.3 Analytical approach

The use of ordinary least squares with fixed effects has been the standard method for examining the effects on organizational performance. However, because even low levels of endogeneity can bias reported coefficient estimates (Semadeni *et al.*, 2014), we also estimated a dynamic panel model as a potential solution for endogeneity problems (Bascle, 2008). Wintoki *et al.* (2012) claim that, in any given period, firms select their board structure to achieve a certain performance in that period, but board structure can also be influenced by performance. Therefore, a method that considers the dynamic relationship between current board structure and past performance may be needed (Wintoki *et al.*, 2012). We used a fixed-effects approach as well as the system GMM approach proposed by Arellano and Bover (1995) and Blundell and Bond (1998) to ensure the robustness of our results. The fixed-effects estimator accounts for unobservable heterogeneity but does not correct for other forms of endogeneity. The system GMM approach can overcome estimation problems caused by unobservable heteroscedasticity, simultaneity and dynamic endogeneity because it is based on an instrumental variables estimation that uses the lags of the variable as estimators, and allows the use of lags of the dependent variable. Moreover, the system GMM model is more efficient than the difference GMM specification because it goes beyond including lagged levels as instruments by including the lagged differences as instruments as well (Roodman, 2006).

For our first estimations, we adopted a fixed effects panel specification, as indicated by a Hausman test ($\chi^2 = 66.69$; $p = 0.000$). Next, we used the xtabond2 module in Stata to estimate our system GMM model (Roodman, 2006). We used a two-step estimator because these estimators tend to perform better than one-step models in estimating coefficients with a lower bias. Moreover, we applied Windmeijer-corrected robust standard errors to control for heteroscedasticity, autocorrelation problems and downward bias in the estimator (Roodman, 2006; Blundell *et al.*, 2001). In addition, we reported diagnostic tests conducted

to confirm estimation validity. The first important test is the Arellano–Bond test of the null hypothesis of no second-order serial correlation in the first-differenced residuals [AR (2)]. Next, we conducted a Hansen test for over-identifying restrictions to test the validity of the instruments, and a difference-in-Hansen test for the endogeneity of the instruments. The nonsignificance of all our tests indicates that the system GMM is an appropriate model specification.

Lastly, although we do not have any indication that the main source of variance will be the between-firm variation, we also performed the Hybrid model and correlated random-effects model to estimate a generalized linear mixed model that splits the effect of cluster-varying covariates on the outcome variable into within-cluster and between-cluster effects. The results show that the curvilinear effect is the result of the within-effect and that the main source of variance is the within variation, not the between variation. Therefore, the choice of a fixed effects model seems strongly supported by these additional results.

4. Results

Table 1 presents descriptive statistics and correlations for the variables used in the analysis. To test for the presence of multicollinearity, we computed variance inflation factors for all variables. Because all the values are lower than the threshold of 4.95, no multicollinearity problem was observed in these analyses. There were no outliers in our data set, as indicated by two measures of influence (DFBETA and cook's D).

Estimates of our models are reported in Table 2. Models 1, 2 and 3 are fixed effects models. Model 1 includes all control variables; Model 2 also contains informational faultlines and its squared term; and Model 3 adds the lagged independent variable. Models 4 and 5 are system GMM models. Wald tests showed that Model 2 is more significant than Model 1 ($p = 0.002$), and Model 5 is more significant than Model 4 ($p = 0.026$). In Model 2, our fixed effect model indicated that the effect of informational faultlines is negative and significant ($b = -0.708$, $p = 0.007$), and the effect of its squared term is positive and significant ($b = 1.765$, $p = 0.001$). These results support our hypothesis that informational faultlines have a *U*-shaped relationship with organizational performance, with the least optimal organizational performance experienced when boards have moderate informational faultlines. In Model 5, the effect of informational faultlines is negative and significant ($b = -1.853$, $p = 0.009$), and the effect of its squared term is positive and significant ($b = 2.960$, $p = 0.009$). To evaluate the size of this effect, the appendix includes several examples of informational faultlines on boards of directors and their firms' corresponding expected ROA (Appendix Table A1). As the expected ROA varies substantially according to the presence of weak, moderate or strong informational faultlines, this effect is not only statistically significant but also theoretically and managerially relevant (Combs, 2010).

To ensure the robustness of our results (Boyd *et al.*, 2017), we estimated our model using a different measure of ROA – namely, operational income before interest, tax, depreciation and amortization (EBITDA), divided by total assets. Furthermore, we controlled for a second lag of ROA to ensure dynamic completeness, which resulted in similar outcomes (Wintoki *et al.*, 2012). Our main findings were robust when subjected to these additional tests. Furthermore, to empirically show that our results stem from informational faultlines rather than board independence, we did a number of additional tests. First, we re-ran the analysis with board independence as an independent variable instead of informational faultlines. Board independence showed no significant effect. In addition, we tested the curvilinear effect of board independence, which also showed no significant effect ($\beta = -0.057$, $p > 0.1$). We also included board independence as an additional control variable in the analysis, which did not alter our results.

Next, following Haans *et al.* (2016), we added a cubic term to the equation to check whether the relationship might be *S* shaped rather than *U* shaped. This cubic term neither improved

Table 1 Descriptive statistics and correlations[a]

Variables	*M*	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1. Return on assets	0.03	0.18	1.00											
2. Return on assets$_{t-1}$	0.04	0.19	0.50***	1.00										
3. Firm age (ln)	3.44	1.06	0.16***	0.17***	1.00									
4. Firm size (ln)	12.73	1.90	0.24***	0.21***	0.25***	1.00								
5. Board size	9.01	3.17	0.14***	0.13***	0.25***	0.64***	1.00							
6. Block ownership	0.43	0.23	0.18***	0.12**	0.30***	−0.02	−0.01	1.00						
7. CEO ownership	0.23	0.29	0.17***	0.18***	0.05	−0.06*	−0.15***	0.59***	1.00					
8. Board heterogeneity	0.49	0.10	0.12***	0.11**	0.21***	0.15***	0.38***	0.06	0.03	1.00				
9. Firm leverage	0.56	0.28	−0.39***	−0.14***	0.02	0.02	0.00	0.05	−0.01	−0.09**	1.00			
10. Social category faultlines	0.13	0.12	0.03	0.03	0.12***	0.22***	0.27***	0.08**	0.08**	0.13***	0.01	1.00		
11. Informational faultlines	0.17	0.08	0.03	0.05	0.12***	0.25***	0.44***	−0.12***	−0.12***	0.41***	−0.07**	0.15***	1.00	
12. Informational faultlines^2	0.03	0.03	0.04	0.06	0.10***	0.21***	0.38***	−0.11***	−0.11***	0.34***	−0.06*	0.12***	0.95***	1.00

Notes: [a]106 public firms (representing 804 firm-year observations) from 2006 to 2014. *$p < 0.1$; **$p < 0.01$; ***$p < 0.001$
Source: Created by authors

Table 2 Effects of informational faultlines on return on assets [a]

VARIABLES	Fixed effects			System GMM [b]	
	Model 1	Model 2	Model 3	Model 4	Model 5
Firm age (ln)	0.063* (0.038)	0.062 (0.038)	0.079 (0.059)	−0.019 (0.035)	−0.013 (0.031)
Firm size (ln)	0.068*** (0.019)	0.064***(0.019)	0.064*** (0.023)	0.074 (0.048)	0.055 (0.046)
Board size	−0.009** (0.004)	−0.008* (0.004)	−0.009* (0.005)	−0.016 (0.039)	−0.003 (0.037)
Block ownership	0.158** (0.067)	0.148** (0.061)	0.119* (0.069)	0.176 (0.225)	−0.021 (0.238)
CEO ownership	−0.006 (0.043)	−0.000 (0.045)	0.014 (0.064)	−0.191 (0.233)	−0.041 (0.231)
Board heterogeneity	0.027 (0.113)	0.056 (0.115)	0.043 (0.122)	0.621 (0.661)	1.052 (0.720)
Firm leverage	−0.437*** (0.070)	−0.439*** (0.070)	−0.458*** (0.063)	−0.509*** (0.120)	−0.427*** (0.131)
Social category faultlines	−0.004 (0.042)	0.015 (0.041)	0.009 (0.044)	−0.027 (0.146)	−0.021 (0.135)
Return on assets$_{t-1}$			−0.031 (0.036)	−0.064 (0.119)	−0.079 (0.107)
Informational faultlines		−0.708*** (0.256)	−0.815** (0.315)		−1.853*** (0.709)
Informational faultlines^2		1.765*** (0.529)	2.031*** (0.688)		2.960*** (1.127)
Year dummies	Included	Included	Included	Included	Included
Industry dummies	Not included	Not included	Not included	Included	Included
Observations	804	804	698	698	698
Number of IDs	106	106	102	102	102
p-Value	0.000	0.000	0.000	0.000	0.000
R-squared	0.475	0.484	0.505		
F-statistic	8.18	8.30	20.68		
Chi-square				92.26	73.98
AR(1) test (*p*-value)				0.068	0.091
AR(2) test (*p*-value)				0.202	0.136
Hansen test of overidentification(*p*-value)				0.510	0.825
Difference-in-Hansen tests of exogeneity (*p*-value)				0.109	0.305
Number of instruments				29	31

Notes: [a]106 public firms (representing 804 firm-year observations) from 2006 to 2014; robust standard errors in parentheses; [b] For system GMM, the first year is dropped, and firms listed for only one year are excluded. $^*p < 0.1$; $^{**}p < 0.01$; $^{***}p < 0.001$

Source: Created by authors

our model fit nor was it significant. Furthermore, another robustness test proposed by these authors involves re-estimating the model after censoring the data by winsorizing. Therefore, we winsorized the data at both the 99th and 95th percentiles and found similar results. Finally, we performed a Sasabuchi test (Lind and Mehlum, 2010) to check the robustness of the nonlinear relationship. The estimated extremum point should be within the data range, and the relationship should be decreasing at the lower bound of values and increasing at the upper bound within the interval. The estimated extremum point for the fixed effect model was 0.20 and was included in the 95% Fieller interval [0.12; 0.25]. Furthermore, the test confirmed the presence of a *U* shape ($p = 0.006$).

In addition, we performed several tests to make sure that the results do not differ according to weak faultline type (i.e. extremely homogeneous versus extremely heterogeneous). We performed a regression analysis on the subsample of boards with weak informational faultlines with Blau's heterogeneity index as the main independent variable to check whether diversity is the main driver of our effects. General board heterogeneity was found to have no significant effect on performance. We also performed a Mann–Whitney test to check whether performance differs significantly between boards with weak faultlines and low diversity and boards with weak faultlines and high diversity. These tests did not indicate a significant difference in performance based on those criteria.

5. Discussion of findings

5.1 A Comparative analysis with previous studies

Research on informational faultlines within the board context and their consequences has been ambiguous. For example, while Shin and You (2022) found that informational faultlines increase the board's ability to dismiss a poor-performing CEO, Kaczmarek *et al.* (2012) and Tuggle *et al.* (2010) find negative effects of informational faultlines on organizational outcomes. These contradictory findings suggest that the relationship might not be simple and linear, as previous studies have assumed (Murnighan and Lau, 2017). In this study, we argued that informational faultlines can lead to knowledge-based subgroups and used the construct of knowledge demonstrability to complement faultline theory in understanding the more complex relationship between informational faultlines within boards and performance outcomes. We demonstrated that informational faultlines in boards of directors have a *U*-shaped effect on organizational performance, indicating that board members are least able to manage their knowledge when informational faultlines are moderate.

5.2 Theoretical implications

Our study contributes to the literature in a number of ways. First, we add to the literature on knowledge management. By investigating the effects of informational faultlines using the concept of knowledge demonstrability, we add to prior knowledge management research that considers the consequences of effective knowledge management (Darroch, 2005; Massingham and Massingham, 2014; Kamhawi, 2012; Cegarra-Navarro *et al.*, 2016; Carayannis *et al.*, 2017; Muhammed and Zaim, 2020). More specifically, building on knowledge demonstrability, we can theorize the importance of signaling where knowledge resides within a group. We add to prior research that considers the importance of knowledge in the particular setting of corporate boards (e.g. Di Vaio *et al.*, 2021). As boards are high-level knowledge-producing decision-making groups that often face nonroutine and complex strategic issues, its members are required to capitalize on each other's knowledge (Forbes and Milliken, 1999; Payne *et al.*, 2009). As such, our study also adds to the literature on knowledge demonstrability (Bonner and Baumann, 2012; Kane, 2010; Laughlin and Ellis, 1986). We respond to a call by Kane (2010) for more work on the role of knowledge demonstrability in work groups that produce knowledge, as the literature has focused on work groups that use knowledge to produce goods and services. Based on the

interesting insights we have uncovered within the domain of corporate boards, we hope that our study will stimulate and guide future academic work on the important and intriguing topic of knowledge management within corporate boards.

Next, we contribute to corporate governance research as we examine informational faultlines exclusively and aim to resolve inconsistencies in prior research that may stem from the implicit assumption that informational faultlines have a linear relationship with performance. We also respond to a call for more research on faultlines within boards, and further inquiry into the presence of subgroups on the board (Shin and You, 2022). We introduce an analysis of the importance of a particular subgroup type on boards of directors – namely, knowledge-based subgroups – and highlight that boards of directors are better able to manage knowledge when strong knowledge-based subgroup identities are maintained.

Moreover, we add to faultlines literature by examining the concept in a corporate board setting, in which it remains understudied. Specifically, we nuance the prevailing idea in faultline literature that faultlines and subgroups are inherently detrimental for groups. Using the concepts of knowledge demonstrability and knowledge-based subgroups, we theorized how boards with strong informational faultlines are better able to manage their knowledge than boards with only moderate informational faultlines because clear-cut knowledge-based subgroups can be positively linked to the four criteria of knowledge demonstrability. By using a new theoretical perspective, we can achieve a better understanding of the faultline concept and implications for work groups.

5.3 Practical implications

Our study has several practical implications. First, our results have important implications for director nomination processes in listed firms. Currently, one of the dominating debates in corporate governance is a gender-balanced representation on boards of directors in listed firms, leading to the instalment of gender quota in many countries worldwide. Although gender quota is important to reach a gender-balanced representation in boards, our results suggest that firms should not only consider director-selection criteria based on a social identity attribute such as gender but should also think of the board as the setting in which multiple individuals work together to provide a strategic direction and improve organizational performance. Creating the optimal context in which directors can manage their knowledge effectively will require that director-selection processes include an analysis of how new human capital (i.e. certain skills, expertise and knowledge) matches the board's current human capital (Withers *et al.*, 2012). More specifically, in director selection-processes, informational attributes such as tenure or education of the individual directors should be closely examined and then analyzed in terms of their similarities (and differences) with those of the other board members to determine knowledge subgroup formation. By strategically recruiting directors, board formations may be set up to optimize the benefits of informational faultlines (Boivie *et al.*, 2016). For example, a recent report on the role of boards in the current ESG and sustainability era (Soonieus *et al.*, 2023) stated that boards generally seem to have sufficient knowledge about sustainability risks and opportunities but not on how to use that knowledge to effectively challenge and monitor management on the execution on sustainability plans. In light of our findings, the results of the report by Soonieus *et al.* (2023) suggest that recruiting directors is not only about looking for additional directors with sustainability knowledge and experience but also about how the knowledge that they bring to the board table could be managed adequately from an informational faultlines perspective.

In addition to the director nomination process, our findings also have practical implications for board functioning. We suggest that board evaluations can be a means to improve board functioning, as they can be used to help the board reflect on its knowledge management. Indeed, during board evaluations, board reflexivity is more likely to transpire, which is

defined as "the extent to which group members overtly reflect upon, and communicate about the group's objectives, strategies and processes, and adapt them to current or anticipated circumstances" (West *et al.*, 1997, p. 296). In this context, board members could initiate discussions about different types of faultlines, realizing that informational faultlines are not inherently negative. Instead, they can reflect on how these informational faultlines look like in their setting and explore ways to harness them to their advantage. These evaluations should also be used to remind board members of their fiduciary duty and responsibility to act in the best interests of the firm (Heracleous, 1999; Van den Berghe and Levrau, 2004) and as such reinforce their superordinate identity as an important condition to reap the benefits of potential informational faultlines.

5.4 Policy recommendations

In this study, we highlight that the management of knowledge is important within the context of boards. While the boards of directors of Belgian listed firms are assumed to be composed of highly qualified individuals, rather than focusing purely on gender quota, we suggest that Corporate Governance Codes could implement certain requirements based on knowledge-based criteria such as expertise, degree and educational specialization.

Stimulating boards to consider appointments to the board of directors with different occupational or educational backgrounds could be an important addition. For example, while the Belgian Corporate Governance Code does stipulate a recommendation of having a financial specialist on the audit committee, it does not specify any other occupational or educational specializations. Furthermore, corporate governance codes could highlight the importance of, not only the availability of board member knowledge, but also the configuration of this knowledge in the board.

5.5 Limitations of the study

As any, this study has some limitations. In developing our hypothesis, we theorized about internal dynamics of subgroup processes. Therefore, future microlevel studies would provide a valuable complement to our study to foster a better understanding of the deeper-level psychological factors underlying subgroup formation and informational faultlines. Therefore, studies using qualitative research designs are needed to more accurately capture the knowledge processes associated with different informational faultlines levels. Furthermore, future studies using an experimental method in a controlled laboratory environment can complement the extant literature based on publicly available archival data (Bonner and Cadman, 2014). Such studies could create a hypothetical board: Participants could play the role of a board member performing a particular board task, and the researcher could create an experiment that manipulates the composition of the particular boards. Investigating different compositions would allow the researcher to examine the formation and make-up of knowledge-based subgroups and the corresponding knowledge processes.

6. Conclusion and future research perspectives

In conclusion, our research suggests that a better understanding of the implications of informational faultlines for organizational performance requires an investigation into the existence of faultlines on boards of directors. Accordingly, this study takes a step toward a more comprehensive investigation of the performance effect of boards of directors by showing that informational faultlines on a board have a *U*-shaped effect on firm performance. However, there might be certain characteristics of a board that could shift the turning point of the curve to the left or right or that might in fact steepen or flatten the curve. For instance, there might be an important role in the specific leadership of the board for the management of knowledge (Merat and Bo, 2013). As leadership has been found to be

central in knowledge management processes (Pellegrini *et al.*, 2020; Yin *et al.*, 2020), board chairs can play a crucial role in moderating the present human capital, and establish a cooperative climate based on shared goals and desired outcomes (Banerjee *et al.*, 2020). Therefore, we expect that the leadership characteristics of the chairman of the board could influence the effect of informational faultlines and the management of knowledge within the board. For example, the personality (Gupta *et al.*, 2019; Bradley and Hebert, 1997) or leadership style (Kanadlı *et al.*, 2018) of the chairman might be important factors to consider. Another direction could be to explore the context of shared leadership on the board (i.e. directors who frequently alternate between the role of leader or follower, depending on the situation and needed capabilities) (i.e. directors who frequently alternate between the role of leader or follower, depending on the situation and needed capabilities; Vandewaerde *et al.*, 2011). Future research might further investigate these potential moderating effects, but to truly measure these mechanisms, detailed survey data may be required.

Future research could also investigate whether the extent of superordinate identity influences the relationship between the effect of informational faultlines and performance because it affects the motivation to perform tasks effectively. Given the importance of the superordinate identity of the board as argued in our theoretical development, subgroups in teams that are not characterized by such overarching identity might be reluctant to share information. On the other hand, cognitive reappraisal by the chairman (i.e. their emotional regulation strategy) could play an important role in decreasing subgroup bias and promoting the exchange of diverse knowledge in the team (Liu *et al.*, 2020).

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Appendix

Table A1 Three examples of boards' informational faultlines and expected return on assets

Example	*Type of directorship*	*Tenure (in years)*	*Educational specialization*	*Educational level*	*Expected return on assets*
Group 1: Weak IFLS[a] (IFLS = 0.00)	Executive	1–5	Business	Master's	9%
	Executive	1–5	Business	Master's	
	Executive	1–5	Business	Master's	
	Executive	1–5	Business	Master's	
Group 2: Moderate IFLS (IFLS = 0.15)	Independent	< 1	Law	Master's	3%
	Independent	> 10	Law	PhD	
	Executive	< 1	Science	Master's	
	Affiliated	< 1	Economics	Master's	
Group 3: Strong IFLS (IFLS = 0.45)	Independent	< 1	Law	Bachelor's	13%
	Independent	< 1	Law	Master's	
	Executive	1–5	Business	Bachelor's	
	Executive	1–5	Business	Master's	

Note: [a] IFLS = Informational faultlines
Source: Created by authors

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