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Board Characteristics and the Insolvency Risk of Non-Financial Firms [†]

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Abstract: How do board characteristics influence the risk of bankruptcy? We study this question by estimating classic Z-Score models using panel data comprising 2519 listed non-financial firms from 29 European countries over the 2012–2020 period. We found that board independence is associated with lower risk of bankruptcy. In contrast, employee representatives have an adverse effect on board monitoring capacity and are predicted to increase bankruptcy risk. The presence of female directors and foreign directors on board—two indicators of board diversity—reduce bankruptcy risk. While board independence and diversity decrease bankruptcy risk in financially non-distressed firms, they have the opposite effect in financially distressed firms. These findings are statistically and economically significant and hold, at least in part, under alternative specifications. Our findings demonstrate the need for governance regulators, credit rating agencies, financial institutions, firms and investors to lend more weight to board composition, especially under the conditions of impending financial distress.

Keywords: corporate governance; board independence; board diversity; bankruptcy risk; Europe

JEL Classification: G15; G30; G32; G33; G34; G39

1. Introduction

On the 25 June 2020, Wirecard—a company regarded as Europe's fintech champion, with a place in the DAX index and a stock market value over USD 28 billion—announced that it was to file for insolvency (McCrum 2020). However, the pressure had already started to mount one year prior after the publication of an article by the Financial Times in 2019, accusing the Wirecard management of engaging in adverse and self-serving behavior and artificially inflating revenues (McCrum 2019). The role of the company's top executives in this scandal and the failure of the board to monitor their activities have since been discussed (McCrum and Storbeck 2022). Formally, Wirecard did not comply with two specifications of the German Governance Code; those being that no supervisory board committees were formed until the first quarter of 2019 and that the chairman of the supervisory board was also the chairman of the audit committee (Jo et al. 2021), thus, raising questions about the composition and governance of Wirecards's supervisory board.

Corporate scandals, such as the downfall of Wirecard, have put German and European regulators under pressure and have raised the question of whether stronger corporate governance mechanisms, including a more effective board role, could prevent corporate insolvency (CGLytics 2020). We study this question with the goal of identifying which board characteristics affect the probability and the predictability of insolvency. Most prior research on predicting insolvency risk rely on financial and accounting data (Altman 1968; Ohlson 1980; Turetsky and McEwen 2001; Campbell et al. 2008; Traczynski 2017; Closset and Urban 2019), with limited emphasis on boards' potential impact.

Board characteristics can affect the probability of bankruptcy through at least two channels. First, as the recent Wirecard scandal suggests, financial and accounting data can be manipulated to conceal the true financial health of a company. Effective boards can potentially improve the accuracy of the financial and accounting information investors and regulators need to assess the true condition of the firm. Second, and more generally, boards can improve, by properly exercising their monitoring and advisory roles, the efficacy of management's response to distress.

We study empirically whether board characteristics correlate with the risk of bankruptcy by estimating classic Z-Score models using panel data comprising 2519 listed non-financial firms from 29 European countries over the 2012–2020 period. Specifically, we investigate whether board independence; CEO duality; the presence of employee representatives on board; and directors' tenure are related to bankruptcy risk. We also study board diversity in terms of the percentage of female and foreign directors and director age.

We report that board independence is associated with lower risk of bankruptcy. In contrast, employee representatives can have an adverse effect on board monitoring capacity and are predicted to increase insolvency risk. Our findings are indecisive for CEO duality and director tenure. Furthermore, we document that the presence of female directors and foreign directors on board reduce bankruptcy risk. These findings are statistically and economically significant and, at least in part, hold under various robustness checks. Directors' age also lowers insolvency risk, although the results are not as robust. We also study whether the influence of board independence and diversity changes under different financial stability conditions. While board independence and diversity decrease bankruptcy risk in financially non-distressed firms, they have the opposite effect in financially distressed firms.

These findings confirm and extend existing research on the link between corporate governance and bankruptcy risk. They are also in line with theoretical considerations on the tradeoffs faced by companies between the knowledge and independence of directors, and their advisory and monitoring roles (Tirole 2010; Adams and Ferreira 2007). For practitioners, these results suggest that managers, shareholders, policy makers, and other stakeholders should consider the overall positive influence of board independence and diversity on the ability to mitigate bankruptcy risk when choosing board governance structures and weighing the tradeoffs a firm faces under its unique economic setting.

This paper proceeds as follows. Section 2 provides a literature review and the motivation for our analysis. Section 3 explains our methods and data. Section 4 presents our results. Section 5 concludes the paper.

2. Literature Review and Motivation

Major theoretical perspectives on corporate governance and organizational behavior, such as Agency Theory (AT) and Resource Dependence Theory (RDT) (Boyd 1995), stress the importance of board composition for firm behavior and firm performance. In particular, the independence and diversity of boards take a prominent position in theoretical and practical considerations. Various factors may contribute towards a board's weakness in carrying out its functions (Tirole 2010). One such weakness lies in the tradeoff between knowledge and independence, weighing the advice and monitoring functions of the board against each other. While inside or non-independent directors can be more friendly to management and therefore less likely to fire managers in case of failure, their higher degree of inside information of the firm can make them better advisors. Under certain conditions, a less independent board may even be optimal to shareholders because they may induce the CEO to share more information with the board (Adams and Ferreira 2007). This tradeoff is emphasized when a firm faces financial distress, as shown by Fich and Slezak (2008), who examined financially distressed firms and documented how board characteristics including board size, board independence, and board ownership reduce bankruptcy. Overall, these findings are consistent with the notion that boards with these characteristics induce more effective monitoring. There is also evidence that board

characteristics may have a differential impact on the bankruptcy risk of different types of firms. For example, Darrat et al. (2016) report that larger boards reduce the risk of bankruptcy only for complex firms and that the proportion of inside directors on the board is inversely associated with the risk of bankruptcy in firms that require more specialist knowledge and that the reverse is true in technically unsophisticated firms.

Another source of weak boards discussed by Tirole (2010) is that of insufficient action. As demonstrated by Adams and Ferreira (2009), board gender diversity can mitigate this concern by increasing engagement and attendance of directors in board meetings and monitoring committees.

In addition, RDT offers a different view on the board of directors. Namely, by viewing it as a source of unique resources and know-how of the firm's external environment, thus highlighting the importance of board independence and diversity (Pfeffer and Salancik 1978). For example, more independent directors can contribute expertise that is unaffected by internal firm policy or sentiment. Moreover, foreign directors can share a more unique intercultural perspective, increasing the board's decision-making quality when voting on internationally relevant strategic decisions.

Furthermore, recent political and practical developments raise the question of whether the push for more board independence and board diversity can significantly influence corporate decision-making and oversight capacity and thereby lower the risk of bankruptcy. The importance of these board characteristics becomes especially relevant parallel to stakeholder demands towards improved governance. Policy makers and regulators are also keen to understand the drivers of corporate downfall.

Europe provides a promising setting to study the relation of board characteristics and bankruptcy risk due to differences in jurisdictions across countries, which stem partly from ownership structures and partly from historical, political, and social path dependencies (Davies et al. 2013). For instance, some countries in our sample have a single board system, while others have a dual-tier board system; some countries provide a statutory right or collective agreements to employee representation at the board-level, while others (e.g., Belgium, Italy, and UK) do not. To mitigate concerns over low comparability between countries due to differences in accounting and bankruptcy regulations, we here study only countries from the European Economic Area (EEA) and listed firms. Thereby economic conditions are comparable, and all firms are required to report under International Financial Reporting Standards (IFRS), ensuring similar accounting practices.

Accounting-based prediction models of insolvency have established a strong link between financial variables and corporate insolvency risk (Altman 1968; Ohlson 1980; Turetsky and McEwen 2001). Meanwhile, management failure has been found to be the most common source of financial distress (Whitaker 1999; Wruck 1990). Correspondingly, AT and RDT state that board independence and board diversity influence the monitoring ability of the board of directors. These theoretical considerations raise the question of whether board independence and board diversity influence the board's ability to prevent management failure and thereby mitigate insolvency risk. The following part discusses how these specific board characteristics may affect the insolvency risk and provide a graphical summary of the main arguments using Figure 1.
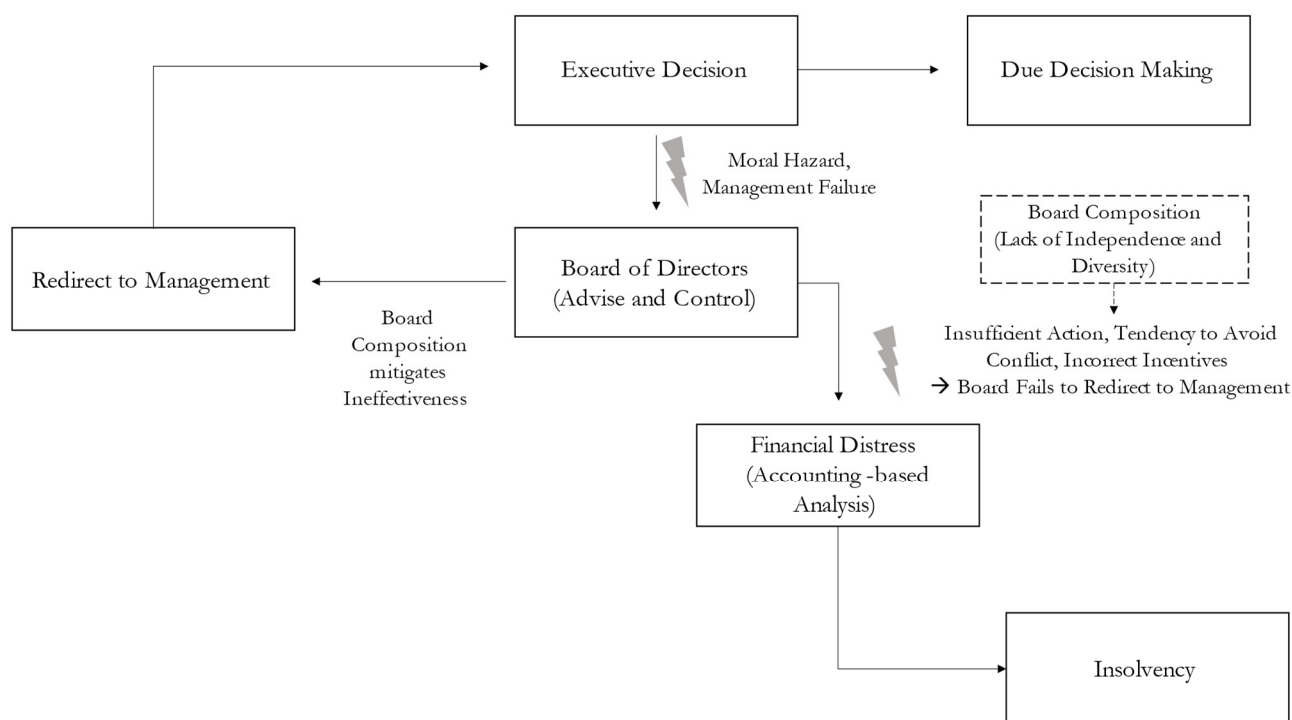
Figure 1. Board Characteristics and Insolvency: Figure summarizes the theoretical considerations to the question of whether board independence and board diversity influence a board's ability to prevent management failure and thereby mitigate insolvency risk.

Board Independence: Management and finance literatures postulate that independent directors function as more effective referees of management decisions than inside board members (Fama and Jensen 1983; Weisbach 1988; Zahra and Pearce 1989). Independent directors are argued to have more experience and expertise and less dependence on management and are therefore credited to improving board monitoring ability (Bathala and Rao 1995), especially in firms with dominant shareholders operating in countries with weak legal shareholder protection (Dahya et al. 2008). However, inside directors can also be a key source of firm-specific knowledge and expertise (Raheja 2005). In addition, management-friendly boards may also be optimal because a CEO is less reluctant to share sensitive and potentially difficult information, thereby potentially limiting the board's influence (Adams and Ferreira 2007; Boone et al. 2007). Hermalin and Weisbach (1998) pose the question of whether boards chosen by the CEO can still be effective monitors.

While there have been a large number of empirical studies relating board independence to firm performance, such studies deliver mixed results, often due to the endogenous nature of this relation (Adams 2017). Research on how board independence correlates with insolvency risk is, however, limited. Fich and Slezak (2008) study a sample of 781 US firms over the period from 1991 to 2000 and find that smaller and more independent boards are more effective in avoiding bankruptcy when a company is already in financial distress, suggesting that board independence increases board monitoring ability, especially in times of crisis. Cao et al. (2015) confirm these findings in a study of US firms cited in the SEC Accounting and Auditing Enforcement Releases (AAER). They study how board size, board independence, and board gender diversity may affect the risk of insolvency and find that the effect of these board characteristics is larger in the post-AAER period. In this sense, the AAER citing is regarded as negative signaling, leading to significant share price drops and pressuring management. Darrat et al. (2016) report that larger boards reduce the risk of bankruptcy only for complex firms and that the proportion of inside directors on the board is inversely associated with the risk of bankruptcy in firms that require more specialist knowledge and that the reverse is true in technically unsophisticated firms. Li et al. (2008)

study non-financial firms listed in China and report that a higher board independence constitutes a lower probability of financial distress and that the effect of independent directors is more significant during financial crises. Based on the theoretical foundations and consistent with previous empirical evidence, we formulate our first hypothesis:

Hypothesis 1 (H1). *A higher percentage of independent directors lowers the risk of insolvency.*

CEO Duality: Board independence has been linked to CEO duality (i.e., the CEO also chairs the board). Such concentration of power can lower board independence and impair board monitoring ability (Jensen 1993). In addition, firms with CEO duality are postulated to be more exposed to information asymmetries (Gul and Leung 2004). At the same time, RDT and stewardship-based theories (Donaldson and Davis 1991) suggest that CEO duality may lead to a more unified leadership, which may enable quick decision-making and translate into benefits for firms in highly competitive and dynamic environments. The prevalence of CEO duality varies across countries. For example, almost half of the S&P 500 firms in the United States combine the two roles (Sun 2019); however, codes of best practice and large institutional investors largely discourage CEO duality in the United Kingdom. As a result, only about 15% of UK-listed firms have CEO duality. Germany prohibits CEO duality altogether (Davies et al. 2013). CEO duality has not been shown conclusively either to improve or to constrain firm performance (Krause et al. 2014). Based on these considerations, we formulate:

Hypothesis 2 (H2). *CEO duality decreases the risk of insolvency.*

Employee Representation: The representation of employees on boards is an important form of employee participation in many European countries. Employee representation can increase board monitoring ability and can add value in coordinating efforts within firms, at least up to a certain threshold (Fauver and Fuerst 2006). A study of Swedish companies confirms the positive influence of employee representation on the board but questions the influence those representatives can exert on managerial decision-making (Levinson 2001). In addition, labor representation has been found to increase cash flows and profits and decrease M&A risk-taking and idiosyncratic risk. Furthermore, it is reported that direct employee influence, opposed to indirect influence, can be a powerful tool to mitigate agency conflicts (Lin et al. 2018).

In contrast, Gorton and Schmid (2004) studied a sample of German firms and found that labor representation on boards may divert companies' objective function from focusing on shareholder value to ensuring employee interests, such as high staffing. The presence of employee representatives can also hinder information flow in line with the notion of friendly boards (Adams and Ferreira 2007). In this context, labor representatives could make executives reluctant to share sensitive information with the board, in fear of being fired or in fear of that information carrying through to lower levels of the workforce. Thus, while the evidence on the influence of employee representatives on firm performance is mixed, it suggests that employee representation can hinder the board's ability to act in crisis situations and to mitigate insolvency risk. Moreover, employee representatives may amplify the bargaining power of labor unions and the workforce and may undermine shareholder interests, thereby augmenting insolvency risk. Therefore:

Hypothesis 3 (H3). *A higher presence of employee representatives on the board will increase the risk of insolvency.*

Tenure: There are two conflicting effects stemming from director tenure: (i) longer director tenure is likely to lead to a more substantial commitment, experience, and competence; however, (ii) directors with longer tenure are also more likely to befriend and less likely to monitor management (Vafeas 2003). Empirically, directors with longer tenures are found to engage in more board committees and have higher insider ownership (Vafeas

2003) and perhaps, thereby, improve firm performance (McIntyre et al. 2007), with some studies documenting non-linearities in this relation (Huang and Hilary 2018; Livnat et al. 2019). Based on these considerations, we formulate:

Hypothesis 4 (H4). *Longer director tenure will decrease the risk of insolvency.*

Board Diversity

Gender: Gender diversity in boards is often seen as a driver of firm values and firm performance through higher diversity and lower discrimination. If diverse teams function better than homogenous teams, a more gender diverse board is likely to increase firm performance (Kahane et al. 2013) and lower the risk of insolvency. This view is supported by Kim and Starks (2016) who found that newly appointed female directors add a higher degree of new skills to the incumbent board than newly appointed male directors and generally possess a more unique set of skills. According to RDT, such changes lead to more effective boards and lower the risk of insolvency (Boyd 1990). The addition of female directors can also lead to a higher turnover of less productive male board members (Hermalin and Weisbach 2003).

While a vast amount of empirical research documents a positive, negative, or no relationship between board gender diversity and measures of firm value and performance (Kirsch 2018; Bui et al. 2020), studies that were able to exploit an exogenous variation in female director appointments report a robust positive effect of female board representation on firm performance, especially when woman directors are actively involved in governance via membership of board committees (Green and Homroy 2018). Thus, we hypothesize that higher board gender diversity is likely to lower the risk of insolvency.

Hypothesis 5 (H5). *A higher percentage of female directors will reduce the risk of insolvency.*

Nationality: A further component of board diversity is the fraction of international directors on the board. It can be argued that international directors bring a more diverse set of opinions and experiences and represent the interests of international shareholders, thereby increasing the monitoring quality of the board (Lee et al. 2018). However, research on this aspect of board composition has been limited, especially with respect to insolvency risk. To test the relation between foreign directors and the risk of insolvency, we formulate:

Hypothesis 6 (H6). *A higher percentage of foreign directors will reduce the risk of insolvency.*

Director Age: Directors' age can be a source of diversity on boards; however, compared with other dimensions (i.e., gender, nationality, and ethnicity), it has attracted limited attention in the study of boards. Age is a dynamic proxy of a director's life experience (Mannheim 1949) and encompasses various elements that influence the formation of personal values during their lifespan (Rhodes 1983). Whether an age-diverse board provides comprehensive resources and expertise or leads to communication breakdown and conflicts remains an open question (Talavera et al. 2018). The evidence on director age diversity and firm performance is mixed, with some studies reporting a positive (McIntyre et al. 2007) and others reporting a negative association (Tsui et al. 1995; Williams and O'Reilly 1998). We do not expect a significant impact of director age on the likelihood of financial distress.

Hypothesis 7 (H7). *Average director age will have no significant effect on the risk of insolvency.*

Financially distressed vs. non-distressed firms: Prior research has argued that board behavior and the management–board relationship can change in times of crisis. For example, otherwise friendly boards could transform into unfriendly boards due to fear of personal liability in case of bankruptcy (Tirole 2010). Consistent with this argument, Fich and Slezak (2008) report the strong predictive power of board governance attributes for bankruptcy conditioning on financial distress. Additionally, previous literature has provided evidence

that directors considerably increase engagement in times of crisis, usually in conjunction with significant share price drops (Vafeas 1999; Cao et al. 2015). We therefore formulate:

Hypothesis 8 (H8). *Under conditions of financial distress, board independence and board diversity will increase the risk of insolvency.*

3. Methodology and Data

In this section, we first present our measure of the risk of insolvency. Section 3.2 details our econometric model. Sections 3.3 and 3.4 report our covariates and data sources, respectively.

3.1. Insolvency Risk

We follow Altman (1968) to operationalize the bankruptcy risk as our dependent variable. The use of Altman's Z-score has been considered by most researchers and practitioners as an effective tool to predict the health of companies. Despite criticisms (e.g., Hillegeist et al. 2004), it has shown to be accurate in empirical studies conducted over the last twenty decades and remains an established tool for assessing the health of companies (Altman et al. 2017). Alternatives to Altman's Z-score is Ohlson's O-score, which uses accounting information and credit ratings that reflect subjective default probabilities provided by credit rating agencies (Blume et al. 1998; Molina 2005). Credit ratings are often used to relate exogenous events, such as acquisitions, to insolvency risk (Aktas et al. 2021; Karampatsas et al. 2014).

The Altman model utilizes a multiple discriminant analysis of a comprehensive vector of financial ratios and thereby provides a holistic view of a company's financial strength (Aktas et al. 2012). In contrast to alternatives based on accounting information, such as Ohlson's O-score (Ohlson 1980), the Z-score employs market values.

Five categories of variables are employed by the Z-score model: liquidity, profitability, leverage, solvency, and activity ratios. To determine the variables with the most significant predictive power of bankruptcy, Altman (1968) considers (i) the statistical significance and relative contributions of each independent variable, (ii) the inter-correlations between the relevant variables, (iii) the predictive accuracy of the various profiles, and (iv) the credibility of the respective analyst. The model defines specific cutoff points to determine the bankruptcy risk of a given firm. Firms with a Z-score below 1.81 are expected to file for insolvency within one year, while firms with a Z-score above 2.99 are not likely to face bankruptcy within one year. The range between 1.81 and 2.99 is defined as a "grey zone".

Altman (1968) proposes the following multidimensional model of bankruptcy prediction:

$$\text{Z-Score} = 1.2x_1 + 1.4x_2 + 3.3x_3 + 0.6x_4 + 1.0x_5,$$

where x_1 represents the ratio of working capital to total assets, x_2 the ratio of retained earnings to total assets, x_3 the ratio of EBIT to total assets, x_4 the ratio of book value of equity to total liabilities, and x_5 represents sales to total assets ratio.

Empirical studies of the Z-score model confirm the model's higher effectiveness in short-term bankruptcy prediction over a time horizon of one year prior to bankruptcy (Reisz and Perlich 2007). Altman et al. (2017) examine the predictive power of the model in an international context, including 31 European and 3 non-European countries and confirm its accuracy of up to 75% in certain countries, while alternatives exhibit outperformance in other countries. This finding indicates significant country-specific differences when predicting bankruptcy, explained by different accounting and bankruptcy regulations. Grice and Ingram (2001) verify the Z-score model with regards to time and industry sensitivity and find that the predictive power of the deployed financial ratios may change over time and is sensitive to industry classification. Thus, when using the Altman Z-score as a measure of financial distress, it is important to include industry- and country-specific control variables.

3.2. Econometric Model

We use the following regression specification, with standard errors clustered on firm-level.

$$\text{Z-Score}_{i,t} = \beta_0 + \boldsymbol{\beta_1} \times \boldsymbol{BC_{i,t}} + \boldsymbol{\beta_2} \times \boldsymbol{X_{i,t}} + f_t + g_j + h_k + \varepsilon_{i,t}$$

Here $\boldsymbol{BC_{i,t}}$ is either a single board characteristic or a vector representing them together; $\boldsymbol{X_{i,t}}$ is a vector of covariates, which we assume to be exogenous; f_t are time effects; g_j are industry dummies defined at the two-digit SIC level; and h_k are country dummies. We also conduct sensitivity analyses using firm-random effects and firm-fixed effects specifications to control for unobserved differences across firms.

We provide estimates pooled across countries and give equal weight to each firm, rather than equal weight to each country. Pooling results across countries involves making the strong assumption that different board governance elements have a similar importance in different countries. At the same time, pooling can help to make sense of results in a multi-country study.

3.3. Covariates

BC comprises both variables on board independence and board diversity. Board independence is operationalized by the percentage of independent directors, the percentage of employee representatives, a CEO/Chairman duality dummy, and director tenure. Independent directors are defined as non-executive directors, who do not have any connections to other stakeholders, thereby excluding executive and gray directors. Employee representatives are defined as directors representing the non-executive employees of the firm (e.g., union representatives). The CEO/Chairman duality dummy indicates whether the CEO is also the chairman of the board of directors (1 if the CEO is chairman, 0 otherwise). Any companies incorporated in countries with a dual board system exhibit a CEO/Chairman dummy of 0. A CEO/Chairman duality dummy of 1 is considered to decrease board independence. Director tenure is defined as the number of years the respective director has occupied his current role. Across firm years it is possible that the director has assumed several different roles, in which case every role is considered as a separate tenure.

Board diversity is represented by the fraction of female directors, the fraction of foreigners, and the average director age. Director gender and age are identified using the personal director information provided by BoardEx. Foreigners are defined as directors that have a different nationality than the country in which the firm is incorporated.

Many firm characteristics are potentially associated with both our outcome variable (Z-score) and with board governance. Failure to control for these characteristics (covariates) can lead to omitted variable bias. Therefore, to reduce potential omitted variable bias, we include the following set of firm specific covariates in vector *X*—Firm Size: ln(total assets) to control for the effect of firm size on the Z-score; Quick ratio: current assets/current liabilities; Leverage: total liabilities/total assets; Sales growth: percentage growth in sales revenue over the last fiscal period; and Capex: capital expenditures/total assets. We also use the natural logarithm of board size as a further control variable. All financial and firm-specific control variables were calculated using lagged values to mitigate potential endogeneity. Table 1 summarizes the definitions of variables.

Table 1. Definitions of Board and Firm Characteristics.

Variable	Definition
Board Characteristics	
% Independent Directors	Number of independent directors/Board size
CEO Duality	1 if Chairman is CEO, 0 otherwise
% Employee Representatives	Number of Employee representatives on board/Board size
Tenure	Years in current role: Role end year–Role start year
% Female Directors	Number of female directors/Board size
% Foreign Directors	Number of foreign directors/Board size
Age	Average age of directors
Other Covariates	
ln(Board Size)	Natural logarithm of number of directors on board
Firm Size	Natural logarithm of total assets in year $t-1$
Quick Ratio	Current assets/Current liabilities in year $t-1$
Leverage	Total liabilities/Total assets in year $t-1$
Sales Growth	$(\text{Sales}_t/\text{Sales}_{t-1}) - 1$
Capex	Capital Expenditures/Total assets in year $t-1$
Financial Crisis Dummy	1 if year = 2011, 2012, 2013, 2020, 0 otherwise

Footnote: the definitions of the explanatory variables used to measure the board composition of the sampled firms. Variables expressed as a fraction of board size are multiplied by 100.

3.4. Data

The data were collected from the databases BoardEx Europe and Compustat Global, provided by the Wharton Research Data Services (WRDS). *BoardEx* Europe provides personal and employer details of directors. In the first step, the datasets were cleaned of duplicate observations and observations of private firms and financial firms. In the next step, all non-board members were dropped from the dataset. In addition, all executive directors of firms in countries mandating a two-tier board system were dropped. This is to ensure that only the supervisory board is included in the study and not the management board, in the case of dual-tier countries. In the case of firms incorporated in single-tier countries all board members were included. After these steps, BoardEx dataset provided information on 185,669 director–year and 19,877 firm–year observations over a period from 2011 to 2020 spanning our sample period.

To compute the Z-score, two *Compustat Global* databases were used. First, the Fundamentals Annual dataset, from which financials were extracted, and second, the Securities daily dataset, in order to calculate equity market values. The Securities daily dataset was cleaned of duplicate observations and private and financial firms. Next, year-end (only 31 December) values were used to compute the market values for each firm. The Fundamentals annual dataset was also cleaned along similar lines. Table 2 reports the means and standard deviations of the Z-score together with the board characteristics by country and of the full sample.

Table 2. Z-Score and Board Characteristics.

Country	N	Z-Score		% Independent Directors		CEO Duality		% Employee Representation		Tenure		% Female Directors		%Foreign Directors		Age	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Austria	257	2.66	1.41	31.90	20.14	0	0	14.13	15.51	4.55	2.2	14.58	12.64	12.09	16.3	56.61	4.02
Belgium	675	2.93	4.94	22.57	19.25	0.04	0.19	0	0	4.18	2.18	21.36	15.34	17.02	20.45	57.31	4.32
Croatia	30	3	1.71	3.38	6.68	0	0	9.39	4.93	2.88	1.33	21.58	17.72	3.52	6.39	53.91	4.53
Cyprus	93	1.59	3.02	25.20	23.32	0	0	0	0	3.22	1.89	16.77	14.02	34.52	20.04	52.91	6.13
Czech Republic	35	3.38	1.33	0.52	2.17	0	0	9.75	12.72	1.48	0.81	15.27	14.47	6.46	12.46	49.01	4.85
Denmark	469	9.23	20.11	35.04	19.13	0	0	19.24	18.21	3.79	2.43	17.76	13.04	19.79	21.77	56.35	3.70
Estonia	18	1.97	0.61	0	0	0.44	0.51	0	0	6.03	1.29	9.52	8.37	4.11	4.75	50.47	3.20
Faroe Islands	16	3.47	4.97	30.10	21.86	0	0	0	0	3.80	2.34	18.33	13.5	23.65	27.04	53.53	5.02
Finland	912	3.31	4.25	53.67	19.7	0	0.07	0.35	2.62	3.04	2.1	24.65	14.61	13.8	19.87	55.52	4.63
France	3631	2.54	4.57	29.36	22.36	0.55	0.5	2.07	5.37	4.88	3.46	27.25	17.04	8.95	15.36	56.49	6.13
Germany	3013	3.5	6.2	12.93	20.11	0	0	12.5	18.34	4.20	2.79	14.37	16.49	10.36	16.92	56.37	6.25
Great Britain	2279	3.32	15.07	41.19	39.14	0	0.07	0	0	3.20	2.88	20.03	32.12	37.04	40.19	57.02	7.09
Greece	234	2.01	1.71	26.16	14.99	0.2	0.4	2.06	5.72	5.19	3.43	6.87	7.94	7.14	10.44	59.31	7.48
Hungary	67	2.20	1.01	45.60	23.02	0.18	0.39	0.15	1.22	4.96	2.54	6.43	10.29	8.37	10.80	56.86	7.00
Ireland	250	2.51	4.36	31.21	19.93	0.02	0.14	0	0	4	2.99	10.23	11.08	29.57	29.41	56.92	4.24
Island	34	69.7	48.03	43.68	18.11	0	0	0	0	3.37	2.46	41.30	13.76	15.08	14.01	54.59	3.08
Italy	1332	2.57	3.92	38.43	18.83	0.16	0.37	0	0	3.93	2.74	25.08	15.19	6.75	15.91	56.38	4.76
Luxembourg	217	3.78	4.63	29.78	23.57	0.23	0.42	0	0	5.13	4.43	11.72	14.77	60.42	28.64	57.35	5.25
The Netherlands	735	2.71	4.87	35.51	20.44	0.4	0.49	0.01	0.37	3.47	1.94	15.88	14.18	33.09	28.74	57.24	5.09
Norway	980	7.44	19.76	36.03	26.54	0	0.05	9.74	14.97	3.20	2.51	40.12	11.82	14.18	18.51	54.18	4.95
Poland	389	4.02	9.47	28.59	21.06	0	0	1.46	5.69	2.81	2.16	13.75	14.40	4.54	10.03	51.15	7.65
Portugal	334	1.28	1.53	16.38	17.99	0.25	0.43	0	0	4.96	4.14	13.26	14.35	8.95	14.83	56.19	5.22
Romania	26	3.83	2.88	31.15	16.26	0	0	0	0	1.60	1.14	19.33	12.12	28.85	16.8	52.18	4.34
Serbia	10	2.08	0.20	25.33	6.66	0	0	0	0	3.88	1.7	4.29	6.90	37.57	10.56	49.00	2.69
Slovak Republic	8	3.18	0.36	0	0	1	0	0	0	3.83	0.67	10.83	8.12	20.32	4.53	56.03	2.37
Slovenia	20	4.18	1.19	0	0	0	0	11.88	15.25	3.29	1.95	35.28	26.34	22.29	32.92	49.42	4.58
Spain	852	1.76	3.86	24.04	18.66	0.24	0.43	0	0	4.34	2.76	15.72	12.25	7.89	13.96	59.53	6.48
Sweden	1717	7.91	17.44	51.44	20.41	0	0	8.82	12.08	3.72	2.31	28.25	14.16	10.39	16.23	56.22	3.89
Switzerland	1244	3.99	7.75	25.25	28.82	0.05	0.21	0	0	4.65	2.97	10.86	11.77	27.8	27.67	58.59	3.96
Full Sample	19877	3.88	10.77	31.52	26.95	0.15	0.36	4.27	11.05	4.04	2.92	21.11	19.25	16.33	24.91	56.54	5.81

Footnote: means and standard deviations of the Z-score and board characteristics by country and in the full sample.

After merging the Compustat Global Securities and Fundamentals datasets with the BoardEx data, we computed all explanatory, dependent, and control variables. We dropped observations for which no Z-score could be determined and winsorized all financial variables at 1% and 99% of their respective distributions to mitigate the potential influence of outliers. We also lost observations because some variables were defined involving their lagged values so that we were able to employ 16,565 firm years in the regressions.

4. Results

4.1. Tests of Hypotheses 1–8

Table 3 reports the results of the regression analysis utilizing data from 2012 to 2020 in the pooled sample of 29 countries. Columns (1)–(7) report coefficients on individual board characteristics when they are estimated in isolation from other board characteristics. In Column (8) we report regression results when all board characteristics are used together to explain the Z-score. All regressions include year, industry, and country dummies, the firm-specific covariates (listed in Table 1), and a constant. We suppressed the coefficients of all variables except for the hypothesized board governance variables. Across all specifications the firm-specific covariates take on expected signs and are meaningfully related to Z-scores. While not hypothesized, the natural logarithm of board size, one of our control variables, captures a consistently positive and highly significant coefficient suggesting larger boards are negatively associated with bankruptcy risk.

Table 3. Board Governance and Risk of Insolvency.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Independent Directors	**0.0179 *** ** **(0.005)**							**0.0117 ** ** **(0.005)**
CEO duality		0.0956 (0.198)						0.193 (0.194)
% Employee Representation			−0.0276 (0.018)					−0.0198 (0.018)
Tenure				0.0104 (0.036)				0.0216 (0.043)
% Female Directors					**0.0217 *** ** **(0.006)**			**0.0209 *** ** **(0.007)**
% Foreign Directors						**0.0210 ** ** **(0.009)**		**0.0205 ** ** **(0.009)**
Age							0.0315 (0.0277)	0.027 (0.030)
Adj.-R^2	0.169	0.169	0.168	0.168	0.169	0.170	0.169	0.173

Footnote: coefficients from pooled regressions for 2012–2020 of Z-score on board governance characteristics and firm-specific covariates (listed in Table 1), with year, industry, and country fixed effects and constant term (coefficients are suppressed). The number of observations for each regression is 16,565. Financial variables are winsorized at 1% and 99%. Standard errors are in parentheses. ** and ***, respectively, indicate significance levels at 5% and 1% levels. Significant results (at 5% level or better) are in **boldface**.

Column (1) reports that board independence lowers insolvency risk. The coefficient on the fraction of independent directors on board is 0.0179 and it is significant at the 1% level. A one-standard deviation increase in the fraction of independent directors is associated with a lower risk of bankruptcy with a 0.48 unit increase in the Z-score (0.0179 × 26.95), which corresponds to almost one-eight of the sample mean of this variable (3.88).

Columns (2)–(4) report the coefficients on CEO Duality, fraction of employee representatives on board, and director tenure, respectively. While CEO Duality and Tenure have positive coefficients, employee representation has a negative coefficient. However, none of these three coefficients translate into statistically significant associations with the Z-score at the conventional levels. We thus conclude that Hypotheses 2–4 are not supported by empirical evidence.

In Column (5) we observe that the fraction of female directors on the board captures a highly significant coefficient consistent with Hypothesis 5. The magnitude of this coefficient (0.0217) is also economically meaningful. A one standard deviation increase in the fraction of female directors on the board is associated with a lower risk of bankruptcy with a 0.42 unit increase in the Z-score (0.0217×19.25). We observe a similar association of the fraction of foreign directors on the board with the risk of bankruptcy. Column (6) shows that the coefficient on this dimension of board diversity is 0.021 is statistically significant at the 5% level and suggests a 0.52 unit increase in the Z-score as the fraction of foreign directors increases by one standard deviation (0.0210×24.91). Hence this result lends empirical support to Hypothesis 6.

Hypothesis 7 posits no significant association between the average director age and the risk of insolvency. In Column (7) we observe that the variable Age captures a positive coefficient, albeit insignificantly. Therefore, Hypothesis 7 is supported by our empirical analysis.

The explanatory power of regressions (1)–(7) is around 16.8%. In Column (8), where we use all board governance variables together, the adjusted R^2 increases to 17.3%. Untabulated regressions show that much of the explanatory power is derived from country and industry fixed effects and that the adjusted R^2 drops to a narrow range of [0.04–0.05] when the country and industry dummies are excluded from the regressions.

In Column (8) we use all board governance characteristics in the same regression equation. The specification is otherwise identical to regressions reported in Columns (1)–(7). We observe that the fraction of independent directors, the fraction of female directors, and the fraction of foreign directors continue to have significant associations with the Z-score, whereas the remaining board characteristics remain statistically insignificant. The magnitudes of the coefficients change, but only marginally, suggesting that the significant results obtained in columns (1)–(7) are not due to the potential correlation of omitted board characteristics and that each of these three variables captures distinct aspects of board structure and diversity.

Hypothesis 8 posits that under financial distress board behavior and the management–board relationship can change so that under conditions of financial distress, board independence and board diversity increase the risk of insolvency. We report the tests of H8 in Panels A and B of Table 4, which use the same specification as Table 3 but restrict the sample to firms with Z-scores < 1.81 (Panel A) and separately to firms with Z-scores > 1.81 (Panel B), following the definition of financial distress suggested by Altman (1968). Columns (1), (5), and (6) of Panel A show that the fraction of independent directors, the fraction of female directors, and the fraction of foreign directors continue to have significant associations with the Z-score with higher coefficient sizes. The size of the coefficient on the fraction of foreign directors on board (0.0323, *p*-value < 0.001) goes up substantially compared to its size in the full sample (0.021, *p*-value < 0.05). These changes suggest that the relevance of these board characteristics is magnified for financially non-distressed firms. Interestingly, in Table 4 the variable Tenure captures a statistically significant coefficient with a negative sign, which contradicts H4, but provides partial empirical evidence to H8 in that it provides further support to the notion that the condition of financial distress affects the way board governance variables are associated with the Z-score. The remaining board governance characteristics (CEO duality, fraction of employee representatives, and director age) remain insignificant. In Column (8) we use all board governance variables together in a single regression and find that board independence loses statistical significance. This is an important change, suggesting that independent directors may turn out to be ineffective for financially non-distressed firms.

Table 4. Board Governance and Risk of Insolvency for Non-distressed and Distressed Firms.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Board Governance and Risk of Insolvency for Non-Distressed Firms								
% Independent Directors	**0.0196 **** **(0.007)**							0.0122 (0.008)
CEO duality		0.1030 (0.274)						0.275 (0.268)
% Employee Representation			−0.0163 (0.022)					−0.0060 (0.023)
Tenure				**−0.1100 **** **(0.045)**				−0.0872 (0.054)
% Female Directors					**0.0243 ***** **(0.008)**			**0.0226 ***** **(0.008)**
% Foreign Directors						**0.0323 ***** **(0.012)**		**0.0308 **** **(0.012)**
Age							0.0070 (0.038)	0.0197 (0.042)
Adj.-R^2	0.233	0.232	0.232	0.232	0.233	0.235	0.232	0.237
Panel B. Board Governance and Risk of Insolvency for Distressed Firms								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
% Independent Directors	0.0022 (0.0027)							0.0025 (0.0028)
CEO duality		−0.0826 (0.1070)						−0.1330 (0.105)
% Employee Representation			−0.0133 * (0.0070)					−0.0133 * (0.0072)
Tenure				**0.0644 ***** **(0.0224)**				**0.0609 ***** **(0.0198)**
% Female Directors					−0.0005 (0.0038)			−0.0002 (0.0037)
% Foreign Directors						−0.00726 (0.0045)		−0.0075 * (0.00458)
Age							0.0105 * (0.0145)	0.0008 (0.0139)
Adj.-R^2	0.515	0.515	0.516	0.515	0.515	0.516	0.516	0.520

Footnote: coefficients from pooled regressions for 2012–2020 of Z-score on board governance characteristics and firm-specific covariates (listed in Table 1), with year, industry, and country fixed effects and constant term (coefficients are suppressed). The sample in Panel A is restricted to 10,882 firm-years of financially non-distressed firms, defined as a Z-score > 1.81 as suggested by Altman (1968). In Panel B, the sample is restricted to 5683 firm-years of financially distressed firms, defined as a Z-score < 1.81. Financial variables are winsorized at 1% and 99%. Standard errors are in parentheses. *, **, and *** respectively indicate significance levels at 10%, 5%, and 1% levels. Significant results (at 5% level or better) are in **boldface**.

　　　Panel B of Table 4 repeats the same exercise for financially distressed firms. We observe that none of the board independence and board diversity measures correlate significantly in this sub-sample. However, Tenure stands out as the only significant board characteristic that lowers the insolvency risk. Overall, the results in Table 4 differ from Table 3 both in terms of the size and significance of key board governance variables, suggesting that financially distressed firms are likely to need a different board configuration than financially non-distressed firms. Thus, these results lend considerable support to H8.

4.2. Alternative Specifications

In our econometric specification we assume exogeneity, which requires, among other things, that current **BC** does not influence future **X**. In many corporate finance applications, including our setting, this condition is unlikely to be strictly satisfied, but it may still be a reasonable approximation. First, prior findings suggest that firm characteristics weakly predict some key board characteristics, such as board independence (e.g., Boone et al. 2007; Linck et al. 2008) and female representation on boards (e.g., Oliveira and Zhang 2022). Second, Bhargava and Sargan (1983) suggest that assuming exogeneity is more reasonable if one uses firm-random effects (firm-RE) or firm-fixed effects (firm-FE) specifications to address unobserved heterogeneity, has a short time dimension, and a time-persistent variable of interest. Both firm-FE and firm-RE will be inconsistent if there are omitted time-varying covariates that are correlated with both the outcome variable and the board characteristics.

All three specifications, pooled OLS, firm-FE, and firm-RE, assume that board characteristics and covariates are uncorrelated with the error term, including cross correlation across time (the "strict exogeneity" assumption). The RE and pooled OLS models make a second, stronger assumption that the firm effects are uncorrelated with the covariates in all time periods, which is unlikely to be a realistic assumption in our setting. Hence, given sufficient time variation in board characteristics, the firm-FE is the preferred specification. However, board characteristics vary slowly within a firm over time, which limits the statistical power of the firm-FE specification. Thus, we consider both firm-FE and firm-RE as useful alternatives to pooled OLS specification. More formally, in (untabulated) tests we find that Hausman tests generally, though not uniformly, favor the firm-FE specifications.

We report the estimates using the firm-FE and firm-RE models in Table 5. Columns (1) and (2) use the full sample, Columns (3) and (4) use the sample of financially non-distressed firms, and Columns (5) and (6) use the sample of distressed firms. The firm-FE results in the full sample show that some of the board characteristics including the fraction of independent directors, female directors and foreign directors, which have a statistically significant association with the Z-score in the pooled OLS specification, become smaller in magnitude and also weaker in terms of statistical significance. In the firm-RE specification (Column (2)), the fraction of independent directors and the fraction of female directors are statistically significant, albeit with a much smaller magnitude of their coefficients compared to the pooled OLS model. In the firm-RE model CEO Duality is also significant; however, with a negative coefficient, suggesting that firms with CEO Duality have higher bankruptcy risk.

Table 5. Board Governance and Risk of Insolvency with Alternative Specifications.

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample		**Non-Distressed**		**Distressed**	
	Firm-FE	Firm-RE	Firm-FE	Firm-RE	Firm-FE	Firm-RE
% Independent Directors	0.0059 (0.005)	**0.0136 *** ** **(0.004)**	0.0078 (0.006)	**0.0162 *** ** **(0.005)**	0.0035 (0.002)	0.0015 (0.002)
CEO duality	0.0001 (0.409)	**−0.725 ** ** **(0.335)**	0.3820 (0.685)	*−0.955 * (0.525)*	−0.1150 (0.168)	0.1380 (0.136)
% Employee Representation	**−0.0258 ** ** **(0.018)**	−0.0027 (0.013)	−0.0176 (0.024)	0.0059 (0.017)	−0.0144 (0.010)	0.0090 (0.006)
Tenure	−0.0330 (0.041)	−0.0425 (0.036)	0.0041 (0.056)	−0.0669 (0.049)	0.0136 (0.021)	**0.0477 *** ** **(0.018)**
% Female Directors	*0.0112 * (0.006)*	**0.0144 *** ** **(0.005)**	**0.0175 ** ** **(0.008)**	**0.0171 ** ** **(0.007)**	*−0.0056 * (0.003)*	−0.0015 (0.002)
% Foreign Directors	−0.0011 (0.006)	0.0035 (0.004)	0.0068 (0.009)	**0.0175 ** ** **(0.007)**	0.0043 (0.003)	*−0.0038 * (0.002)*
Age	**0.0437 ** ** **(0.022)**	*0.0342 * (0.019)*	**0.1040 *** ** **(0.034)**	**0.0645 ** ** **(0.028)**	−0.0154 (0.010)	*−0.0143 * (0.008)*
R^2	0.030	0.055	0.023	0.115	0.483	0.273

Footnote: coefficients from firm-fixed effects (columns (1) and (3)) and firm-random effects (Columns (2) and (4)) specifications for 2012–2020 of Z-score on board governance characteristics and firm-specific covariates (listed in Table 1), with year, industry, and country fixed effects, and constant term (coefficients are suppressed). Columns (1) and (2) use the full sample. Columns (3) and (4) use the sample of financially non-distressed firms (Z-score > 1.81) and Columns (5) and (6) use the sample of distressed firms (Z-score < 1.81). Industry and country dummies drop in the firm-fixed effects specification. Financial variables are winsorized at 1% and 99%. R^2 is the within R^2 for the firm-fixed effects specification and the between R^2 for the firm-random effects specification. Standard errors are in parentheses. *, **, and ***, respectively, indicate significance levels at 10%, 5%, and 1% levels. Significant results at 5% level or better (10% level or better) are in **boldface** (*italics*).

Columns (3) and (4) study the sample of financially non-distressed firms. In the firm-FE model (Column (3)), we observe that the fraction of female directors is statistically significant at the conventional level; however, board independence and foreign directors do not correlate significantly with the Z-score. In the firm-RE model in Column (4), we again confirm that the percentage of independent, female, and foreign directors is statistically significant. In both specifications directors' age is significantly associated with lower bankruptcy risk.

In Columns (5) and (6), we study the sample of distressed firms. It is worth noting that none of the board governance and board diversity measures has an economically and statistically meaningful association with the Z-scores of firms in this sample both with firm-FE and firm-RE specifications. Director tenure in the firm-RE specification is an exception, suggesting that directors with longer tenure are likely to lead to a lower insolvency risk. These results are substantially different for the pooled OLS results and also indicate fundamental differences in the potential impact of board independence and board diversity for financially distressed and non-distressed firms.

It is also worth noting that the explanatory power of firm-FE (within-R^2) and firm-RE (between-R^2) are substantially lower compared to the adjusted-R^2 in the pooled OLS. This difference demonstrates that a large part of the predictive power of the regression model is due to cross-sectional differences across firms, due to unobservable firm-specific attributes.

In (untabulated) regressions we also conduct significance tests for the coefficients of interest using standard errors clustered on industry-level and generally confirm our prior findings using all three specifications.

5. Conclusions

Prior research provides evidence that financial and accounting variables have strong predictive power for the insolvency risk of companies. However, relatively little research has been conducted to analyze whether board characteristics contribute to the predictive power of such models. We seek here to contribute towards this literature using a cross-country sample of European companies, a rich dataset on board governance, and a robust empirical setting with panel data and extensive covariates, including controls for some other aspects of governance.

The findings of our empirical analysis can be summarized under three main points. First, the independence of board members can facilitate board-monitoring capacity and mitigate insolvency risk, but firms must recognize and balance the tradeoff between knowledge and independence when determining board composition. Second, board diversity clearly helps firms prevent bankruptcy by introducing unique resources and expertise to firms. These results speak to efforts to introduce legislative action to address gender imbalance in the European Union (European Commission 2012, 2022) and strengthen the business case for board diversity. Finally, the effectiveness of board independence and diversity characteristics in mitigating insolvency risk depends on the financial stability of a given firm, underlining the ambivalent nature of these factors.

Collectively, we provide evidence that observable board governance characteristics enhance the predictive power of models of insolvency risk. At the same time, our alternative specifications using firm fixed and firm random effects highlight the need to consider the role of hard to observe and often firm-specific factors that may systematically shape board composition in the background (Hermalin and Weisbach 1998, 2003; Adams 2017). In our study these factors are further augmented by the heterogeneity of the dataset with respect to both country and industry affiliation. Our results highlight the need for scholars and practitioners, such as governance regulators, credit rating agencies, and financial institutions, to better understand the drivers of board composition, especially for firms under different conditions of financial distress.

Further research can be conducted to assess whether our results were driven by particular subsamples. This exercise can be conducted to by splitting the sample into countries or groups of countries based on institutional characteristics, such as legal origin, strength of enabling institutions, or degrees of economic development. Following prior research (Cathcart et al. 2020), it is also meaningful to split the sample into industries, such as manufacturing versus services, or large versus small firms, high-growth versus low-growth firms, or old versus young firms. Similarly interesting would be an analysis of the role of boards in different stages of financial distress and also through economic cycles (Huang et al. 2011).

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