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Board Structure and Corporate R&D Intensity: Evidence from Forbes Global 2000

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Board Structure and Corporate R&D Intensity: Evidence from Forbes Global 2000

Abstract

Purpose – This study seeks to examine the impact of board structure on risk-taking measured by R&D intensity in OECD countries.

Design/methodology/approach – The study uses a panel data of 200 companies on Forbes Global 2000 over the 2010- 2014 period. It employs the ordinary least square multiple regression analysis technique to examine the hypotheses.

Findings - The results show that the frequency of board meetings and board size are significantly and negatively related to risk-taking measured by R&D intensity, with a greater significance among Anglo American countries than among Continental European countries. The rationale for this is that the legal and accounting systems in the Anglo-American countries have greater protection through greater emphasis on compliance and disclosure and therefore allowing for less risk-taking.

Research limitations/ implications – The results suggest that better-governed firms at firm- or national-level have a high expectancy of less risk-taking. These results offer regulators a resilient incentive to pursue corporate governance and disclosure reforms officially and mutually with national-level governance. Thus, these results show the monitoring and legitimacy benefits of governance, resulting in less risk-taking. Lastly, the findings offer investors the opportunity to build specific expectations about risk-taking behavior in terms of R&D intensity in OECD countries. Future research could investigate risk-taking using different arrangement, conducting face-to-face meetings with the firm's directors and shareholders.

Originality / value – This study extends, as well as contributes to the extant CG literature, by offering new evidence on the effect of board structure on risk-taking. The findings will help policymakers in different countries in estimating the sufficiency of the available CG reforms to prevent management mishandle and disgrace.

Keywords: R&D, Corporate Governance; OECD Countries; Frequency of Board Meetings; Board Size; Forbes

1. Introduction

This study examines the impact of internal corporate governance (CG) mechanism on risk-taking during the period 2010 to 2014 in OECD countries. Different country characteristics extend a major degree of influence on the different systems of corporate governance (CG) under which firms execute. Different legal systems impact the quality of the corporate rights that firms must meet. Legal systems are significant because of the serious external controls that they extend on firms dealing with them (Adel et al., 2019; Alshbili & Elamer, 2019; Elamer et al., 2018, 2019a, b; Elmagrhi et al., 2017; Hassan et al., 2019; Nish, 2015; Ullah et al., 2019; Yu & Wang, 2018). Thus, this study contributes to current research by analysing how CG mechanisms are mightily determined by certain countries in which firms operate, and how CG mechanisms that are set to be useful in these countries are based on legal, accounting and auditing practices as well as on ownership issues that are combined in those countries. On the other hand, culture impacts attitudes and corporate values in different firms (AlHares and Ntim, 2017).

The literature on the relationship between frequency of board meetings, board size and firm performance, particularly with respect to risk-taking, is not conclusive. For example, previous research is inconclusive on whether board monitoring positively (e.g., Kor, 2006) or negatively (e.g. AlHares et al., 2018; Deutsch, 2005, Yoo and Sung, 2015) impacts firms' R&D intensity. More specifically, there is a dearth of studies on how different corporate governance mechanisms used by companies influence the risk-taking (Switzer & Wang, 2013; Matthies, 2013; Tran, 2014). Consequently, this study seeks to contribute to the extant literature by addressing the limitations of previous studies via an empirical examination of the relationship between corporate governance and risk-taking. According to Vafeas (1999), some believe that frequent board meetings and board size would ultimately have a positive impact on a firm's risk-taking, but another view holds that board meetings and board size do not benefit shareholders of a firm. However, there appears to be more support for board structure benefitting forecasts of management earnings (Karamanou and Vafeas, 2005). Another study shows that board structure contributes to improved firm performance (Mangena and Tauringana, 2006). Also, Yu and Wang (2018) suggest that firms with comparatively robust corporate governance instruments, stakeholders tend to have more correct beliefs about firms' future performance, less asymmetry, and investor expectations about earnings change more slickly over the year. This implies that corporate governance performs a significant part in the

expectedness of firm's future performance and, thus, advances the financial environment (Agyemang-Mintah and Schadewitz, 2019; Ko et al., 2019; Sial et al., 2019; Ullah et al., 2019; Waresul Karim et al., 2013; Zouari and Zouari-Hadiji, 2014).

Extant research offers inconclusive evidence on the association between board of directors and decisions regarding R&D intensity (Bravo and Reguera-Alvarado, 2017; Chen, 2013, 2014; Dalziel et al., 2011; Tseng et al., 2013). Previous research shows that the level of R&D intensity is valued for firms, regardless of the industry (Bravo and Reguera-Alvarado, 2017; Eihe and Olive, 2010). Several studies suggest that R&D activities are highly risky with their returns being highly uncertain (Pindado et al., 2015), and thus, the question of how board of directors' characteristics may influence R&D choices within a company is a significant issue in the research related to both corporate governance and R&D. This study contributes to the current literature (Bravo and Reguera-Alvarado, 2017; Chen, 2014) by theoretically integrating both agency theory and resource dependence theory by investigating the possible relation between two directors' characteristics board size and board meetings and strategic choices re R&D intensity. This sheds light on the impact of board of directors characteristics on the application of R&D plans by in view of both resource agency theory and dependence theory. Our theoretical basis suggests that only directors with adequate resources can make risky and puzzling decisions and encourage R&D plans. Though, these plans are complex and need a great deal of participation. So, the board of directors need to completely extend their monitoring activity to endorse and support these plans (Ben-Amar et al., 2013; Bravo and Reguera-Alvarado, 2017).

Countries in the OECD differ with respect to their legal, accounting and auditing practices, as well as ownership and debt issues. The two major legal systems operating among nations in the OECD provide firms with different legal rights-based respectively on the common law system, as in the US and the UK, and the civil law or code law system, as in Germany and France (Radebaugh et al., 2006). While the common law system offers protection to small individual shareholders, the civil law system provides excellent protection for large institutional shareholders (Radebaugh et al., 2006). The critical differences between the two legal systems are the rights and remedies they afford shareholders. Risk-taking, therefore, respond differently in the countries using the two major legal systems.

Risk-taking is an essential concept because it affects performance, and how a firm deals with risk-taking through its corporate governance mechanisms also affects its shareholders and debt holders. Weak governance can lead to more significant financing costs for higher debt.

This necessitates shareholders and debt stakeholders being knowledgeable about the rules pertaining to governance in the firm as well as in the country in which they are invested. It is, therefore, in the interests of shareholders and debt stakeholders to know that the companies in which they invest have good monitoring systems that ensure that management is truly representing their interests.

It is predictable in this paper that what impact CG would impact R&D. The question to be raised in this study is, how does board structure moderate the assessment of R&D in firms?

All firms used in this study are listed in the World's Biggest Public Companies listing, Forbes Global 2000 Leading Companies (Forbes, 2000). The sample is made up of 200 firms from 10 OECD countries. The results show a negative and statistically significant relationship among frequency of board meetings, board size and risk-taking as measured by the intensity of R&D in the firms. The result is consistent with those of prior literature. Moreover, firms in different countries show a negative relationship between frequency of board meetings, board size and risk-taking, but that this relationship is shown to be much smaller in the Continental European countries than in the Anglo-American countries. The rationale for this seems to be that in the Anglo-American countries, the accounting and legal systems in the Anglo-American system has greater protection through greater CG and heavy emphasis is placed on compliance and disclosure and therefore allowing for less risk-taking.

This study contributes to extant research on board of directors features and R&D intensity by emphasising that both agency theory and resource dependence theory should be cogitated to know the influence of board size and board meetings in mitigating risk-taking measured by R&D intensity. We theoretically suggest and empirically show that the board size and board meetings negatively affect risk-taking measured by R&D intensity. The integration of both theories helps to well understand the role of board size and board meetings in R&D choices. We extend previous research by AlHares et al. (2018), who examined the impact of ownership structure on R&D intensity. We add to this research by examining additionally the impact of board of directors characteristics on R&D intensity. Thus, our findings will help policymakers in different countries in estimating the sufficiency of the available CG reforms to prevent management mishandle and disgrace.

The rest of the paper is structured as follows. The next section provides a brief overview of our multi-theoretical framework. The following section presents the literature review and

hypotheses development. The remaining sections outline the research design, report empirical analyses and provide a conclusion.

2. Multi Theoretical Framework

The theories that can be used to discuss this relation between board structure and risk-taking is agency theory, which shows the importance of looking after the interests of shareholders and promoting firm performance; and resource dependence theory, since the board serves as a resource, improving firm value; More frequent meetings and board size may help give the impression that the firm has a board that is actively working.

2.1 Agency theory

Garmaise and Liu point to the fact that managers of organisations under the agency theory are prone to investment, even when there is an indication that conditions may not be ideal. Dishonest managers would expose the organisation to systemic risks by taking chances and investing when there are indications that this may not be the best decision. In these instances, dishonest or corrupt managers are generally looking out for their own self-interest.

From an agency perspective, information asymmetry inherits in R&D make considerable agency costs. R&D projects are inclined to adverse selection since managers are usually better informed regarding a project's specific features, its value, and probability to succeed (AlHares et al., 2018). In contrast, shareholders might be often misguided by the ambiguous disclosure because signaling costs are high (i.e., leak of important technological information through disclosure may passes down the competitive advantage to the hands of its possible competitors (Rapp and Udoieva, 2017). Also, shareholders cannot evaluate the reasons behind management's behavior who may want to use specific investments to enhance there own market value and human capital returns.

R&D intensity is widely employed as a proxy of risk-taking in business research (AlHares et al., 2018; Elmagrhi et al., 2017) as they have costs. First, intensifying R&D involves a greater risk of bankruptcy (De Massis et al., 2018). Second, as R&D intensity reduces the amount of resources unreservedly accessible to managers, it is likely to consider as limiting managers discretion. Third, increasing R&D investments often requires increase leverage or seeking external fund, which may sequentially force managers to reveal strategic information to outside professionals with the technical background and experience required to administer such activities (Gómez-Mejía et al., 2010).

But another risk to the agency theory comes from the stakeholder perspective, which sees risk as associated with the failure of corporate governance to take into consideration the interests of all stakeholders (Letza et al., 2004). The risks for the other stakeholders would be greater if corporate governance does not insist on all stakeholders and not just shareholders. Agency theory suggests that board of directors should also monitor plans and/or strategies implementation to hinder managers from performing opportunistically to the detriment of shareholders (Bravo and Reguera-Alvarado, 2017; Pugliese et al., 2009). Hence, the board of directors may improve specific strategies that are linked to firm performance, such as the risk-taking.

2.2 Resource dependence theory

A well-established body of literature shows that R&D investments imply dealing with ambiguity and firms need to be good at handling the idiosyncratic risk of R&D investments (AlHares et al., 2018; Rapp and Udoieva, 2017). The challenging task of R&D investments lie in a number of risk-inflating dimensions such as real uninsurable uncertainty, moral hazard, sunk costs, long open-ended time intervals between expenditures and eventual pay-offs, adverse selection, and sensitivity to fluctuations in a supply of human resources (Bakker 2013; Rapp and Udoieva, 2017).

Resource dependence theory holds that the boards of directors are important to the functioning and performance of the organisation because the expertise and the connections with others in the outside environment that individual board members have helped the organisation in securing resources for the organisation (Letting et al., 2012; Abdullah& Valentine, 2009). The corporate board and outside directors are therefore seen as important for the promotion of the performance of the organisation. More than that, the board member diversity and the external networks among board members and other organisations are important factors for resource dependence theory (Letting et al., 2012).

From a resource dependency theory perspective, organisations face risks associated with obtaining the needed resources. This theory holds that organisations are constrained by the environment, especially by their situations, but that they could engage in exchanges and transactions that would allow them to overcome these constraints (Chen & Roberts, 2010). Risk-taking results when there is a lack of skills and knowledge within the organisation in order to carry out its operations successfully. Thus, the board of directors with significant resources are in a brilliant situation to contribute to firm strategy, especially those involving risk-taking

(Bravo and Reguera-Alvarado, 2017; Pugliese et al., 2009). Specifically, board size and board meetings may contribute to expanding the human and social capital of boards by delivering boards with such information and resources, and deter risk-taking.

3. Literature Review

3.1 Frequency of board meetings and R&D intensity

Researchers pass interest on whether the frequency of board meetings is associated with the financial performance of firms. Theoretically, there are questionable viewpoints as to the influence of frequent board meetings on risk-taking. On the one hand, the frequency of board meetings can benefit in decreasing agency conflicts by passing on information to management and agents transparently (Elmagrhi et al., 2017). It was also notified that more frequent board meetings lead to more monitoring of managers, which can improve performance including control R&D intensity (Bravo and Reguera-Alvarado, 2017; Ntim, 2016; Ntim, 2013; Vafeas, 1999). It was also thought that organised meetings allow directors the chance to explore strategies and to more frequently estimate how managers are accomplishing their objectives (Vafeas, 1999). Mangena and Tauringana (2006) argue that managers receive adequate information about the firm and have the opportunity to address firmly developing problems when they meet frequently. Additionally, more board meetings improve closer bonds among directors (Lipton and Lorsch, 1992).

An opposing view suggests that shareholders do not acquire a lot from board meetings as the goals of these meetings will not be achieved. Frequency of board meetings does not fulfil much since the time that board members spend together does not really involve much actual exchange that is relevant to shareholders. This is because of the amount of routine involved in board meetings (Vafeas, 1999). Lipton and Lorsch (1992) argue that frequent board meetings do not assist shareholders because meetings waste time from management to monitor others. Specifically, Vafeas (1999) argues that frequent board meetings cost the organisation, in terms of expenses to cover travel, refreshments and other board activities and are spent on routine tasks. This leads us to propose the following hypothesis:

H1: *There is no statistically significant relationship between the frequency of board meetings and R&D intensity*

3.2 Board Size and R&D intensity

Structure of the board is crucial as it gives a share into the capabilities of the board. According to Solomon (2007), a board should be made up of professionals drawn from diverse backgrounds and with expertise that allows board members to complement each other. While the size of the board is definitive, for a large board of directors is believed to be unfavourable according to agency theory (Sonnenfeld, 2002). Minimal board is seen as being seen as more functional and as having the chance to motivate management (Lipton and Lorsch, 1992). As with large board, the CEO of firm can control because of the need for coordination among many board directors (Jensen, 1993). To forego this negative aspect of board size, Lipton and Lorsch (1992) recommend limiting the number of directors on board and thereby preventing social loafing and free riding as some directors would not put out the effort that they could have done in a smaller group.

Several recent studies have investigated the influence of board size on firm strategy. Elmagrhi et al. (2017) suggest that board size has an impact on board involvement in dividend pay-out decisions. Particularly, a number of studies have implied that board size negatively influences strategies on dividend pay-out, disclosure and risk-taking (Alnabsha et al., 2018; Alshbili et al., 2019; Elamer, 2017; Elamer et al., 2018, 2017, 2019a, b; Elmagrhi et al., 2017; Ntim, 2016; Ntim et al., 2012). Regarding the firm performance, Shakir (2008), Yokishawa and Phan (2004) show a negative relationship between board size and firm performance, which reinforced the inference of Jensen (1993). Haniffa and Hudaib (2006) suggested that a large board is seen as less effective in monitoring firms and costly in terms of compensation. However, Al-Matari et al. (2012) found no relation between board size and firm performance using a Kuwaiti sample. Regarding firm risk, Pathan (2009), Cheng (2008), Platt and Platt (2012), and Mathew et al. (2016) find a significant negative association between firm risk and board size. This leads us to propose the following hypothesis:

H2: *There is no statistically significant relationship between the board size and R&D intensity*

4. Research Methodology

4.1 Sample and data considerations

The sample consisted of 200 firms drawn from the OECD countries, 20 firms selected from 10 different countries. All companies selected in this study are listed in the World's Biggest Public Companies listing, Forbes Global 2000 Leading Companies (Forbes, 2000). Two different

traditions were considered in this study: the Anglo American and Continental European traditions. Countries included in this study from the Anglo tradition are Australia, Canada, Ireland, UK and the US. The remaining 5 countries are France, Germany, Italy, Japan and Spain, which represent the Continental European.

Annual reports are the major source of information in this study and data obtained for the years between 2010 and 2014 from the Perfect Information Database and firms' website.

4.2 Definition of variables and model specification

This study examines the influence of internal CG mechanisms, including the frequency of board meetings and board size on firms' risk-taking within the OECD context. The variables used in this study are summarised in table (1). The CG variables were collected from the companies' annual reports, which were obtained from their websites. This study measures firms' risk-taking by calculating the natural logarithm of the percentage of R&D expenditure divided by total sales, which is the most frequently used ratio in prior studies. (Ntim et al., 2018; Honoré, 2015)

Internal CG mechanisms variables include board size *(BZ)* and frequency of board meetings *(FBM)*. Control variables include sales growth *(SG)*, firm's size *(FS)*, audit committee *(AC NO)*, corporate governance committee (*CGC NO*), leverage *(LVG*), corruption index *(CORR IDX)*, inflation *(INFL)*, gross domestic product per capita *(GDPC*), population *(POP)* and Power Distance *(POWD)*.

INSERT TABLE 1 ABOUT HERE

Ordinary least squares (OLS) regression would be used to test our hypothesis and the following model is proposed

$$RT_{it} = \alpha_0 + \beta_1 BZ_{it} + \beta_2 FBM_{it} + \sum_{i=1}^{n} \beta_i FCONTROLS_{it} + \sum_{i=1}^{n} \beta_i CCONTROLS_{it} + \varepsilon_{it} \quad (1)$$

5. Results

5.1 Descriptive analysis and bivariate correlations

Table 2 shows a summary of the descriptive statistics of the dependent and independent variables. The minimum board size of all firms is (5), while the largest (22) and these are the same statistics for the overall period as well as for each year. This is because the boards that were studied remained the same throughout. The average size for the overall period was (12.23) and this fluctuated only a little over this period with the least being (12.10) in 2006 and the

greatest being (12.28) in 2012. The minimum number of board meetings was (0) and the maximum was (35) in the overall sample period. The average over the sample period is (8.08) and the standard deviation is (3.957). The findings show that R&D/Total sales ranges from a minimum of (.000029) to a maximum of (1.094466) with an average of (.045) for the overall sample period of 2010 to 2014. The standard deviation is (0.96), which does not represent a major range. The mean or average is relatively stable over the period except in 2014, where it is relatively smaller. The standard deviation fluctuates over the period and shows that individual years have different ranges

INSERT TABLE 2 ABOUT HERE

The results of correlation matrices are demonstrated in table 3. The coefficients of Pearson's and Spearman's are used as a robustness check.

INSERT TABLE 3 ABOUT HERE

6. Empirical findings and discussion

Table 4 shows a statistically significant and negative relationship between the frequency of board meetings and risk-taking measured by R&D/Sales, thereby providing empirical support for H1. This relationship proposes that the more board meetings are held, the lower the risk-taking. This relationship is based on the idea that frequent board meetings mean greater monitoring of management. The overall average for all firm years is (-4.286***) for the frequency of board meetings. This finding shows that there is a negative relationship between the frequency of board meetings and risk-taking, significant to 1%. This suggests that when meetings are more frequent, risk-taking will decrease. Board size has been touted as an important factor in the success of a board and in the success of a firm's performance, but others have argued that either size did not matter or else too large a board could be detrimental.

Hypothesis H2 has been used to show the relationship between board size and risk-taking measured by R&D/Sales, and states that "there is no statistically significant relationship between the board and R&D intensity". The findings show that there is a negative relationship. A negative result shows that a strong board has a negative impact on risk-taking, because of protecting the shareholders' interests and keeping management from pursuing their own self-interests. The theories that are used in explaining this finding are agency theory and resource dependence theory. Consistent with this notion, Cheng (2008) suggests that US companies with bigger boards are related to lower performance volatility. Likewise, Nakano and Nguyen (2012) suggest that firms with larger boards show lower performance volatility as well as lower bankruptcy risk. Similarly, Adams and Ferreira (2010) show that larger groups are less extreme

in their gambling decisions, while Bar et al. (2005) reveal that team-managed mutual funds are less likely to deviate from their professed investment styles compared to individual managers. Also, our results support Wang (2012), who suggest that larger boards are willing to reject risky policy choices aligned with the shareholders' interest.

According to agency theory, board members protect shareholders' interests through their surveillance of management (Vafeas 1999; Mangena and Tauringana, 2006). This finding supports studies, including Karamanou and Vafeas (2005), who show that among 275 U.S. listed companies, frequent board meetings had a positive effect. However, another view is that more frequent boards meetings result in higher costs for boards and firms, eventually leading to poor performance. The theories that can be used to discuss this relationship between frequency of board meetings and risk-taking is agency theory, which shows the importance of looking after the interests of shareholders and promoting firm performance; and resource dependence theory, since the board serves as a resource, improving firm value. More frequent meetings may help give the impression that the firm has a board that is actively working. Our results are consistent with previous research. For instance, Battaglia and Gallo (2017) find that firms with lower frequency of board meetings per year confront more severe losses than other firms.

Firm size is also significant, but at 5% and negative. Firm size mattered as firms of different sizes had different CG structures. Differences in firm size affected risk-taking. In terms of audit committees, here was also a negative relationship, significant at 10%. This meant that an increase in the audit committee led to a reduction in risk-taking. Significance to CG committee number was (5.126***) significant at 1%. This suggests that when CG increases, so does the likelihood of investment in R&D (Black et al., 2010). Audit committees would lead to an increase in the creditworthiness of the company, as these committees carry out more surveillance of firms, leading to better protection of shareholders' interests (AlHares et al., 2018; Lai & Chen, 2014).

With the country variables, Anglo-American corruption index and power distance have relations with risk-taking that are significant at 1%. Corruption index, power distance and Anglo-American have a positive relationship. The findings are (2.005**) for corruption index, (3.493***) for power distance and (4.578***) for Anglo-American. An increase in corruption index and power distance led to increase in risk-taking. The positive significance of Anglo-American means that firms from Anglo countries perform better in terms of risk-taking than firms from Continental countries. This reflects the fact that the Anglo-American system leads

to a decline in risk and, ultimately, in credit risk. According to research, since the Anglo-American tradition has rigid CG mechanisms established by country practices, heavy emphasis is placed on compliance and disclosure, leading to reduced risk-taking (Jenkinson and Mayer, 2012).

INSERT TABLE 4 ABOUT HERE

7. Conclusions

The study examines the impact of internal CG mechanisms on companies' risk-taking during the period 2010 to 2014 in OECD. The results show a negative and statistically significant relationship among frequency of board meetings, board size and risk-taking as measured by the intensity of R&D in the firms. The result is consistent with those of prior literature.

Moreover, firms in different countries show a negative relationship between frequency of board meetings, board size and risk-taking, but that this relationship is shown to be much smaller in the Continental European countries than in the Anglo-American countries. The rationale for this seems to be that in the Anglo-American countries, the accounting and legal systems in the Anglo-American system has greater protection through greater CG and heavy emphasis is placed on compliance and disclosure and therefore allowing for less risk-taking.

Frequency of board meetings is significant and negative. This supports the position that the more often board meetings are held, the less risk there is. The literature shows that frequent meetings can lead to a reduction in risk (Karamanou and Vafeas, 2005). This may be because more frequent board meetings mean more monitoring of management, thereby reducing risk-taking (Vafeas, 1999). This is based on the idea that there is more strategising at board meetings, thereby promoting more creative solutions to problems (Vafeas, 1999). Frequent board meetings were also thought to be effective in promoting closer ties between members (Lipton and Lorsch, 1992). But Vafeas (1999) suggests that the argument can be made that more frequent board meetings do not help, because more costs are associated with holding these meetings.

This study has contributed to existing research by investigating the relationship between CG mechanisms and companies' risk-taking, which has rarely been addressed by previous studies. Our paper improves the relation between agency theory and resource dependence theory by suggesting that board size and board meetings mitigate risk taking measured by R&D intensity, nevertheless only if board of directors can achieve their monitoring activity effectively. Empirical results suggest that board size can create benefits and affect corporate risk-taking strategy because of the skills, networks and/or knowledge, which they obtain in the boards that they sit on. Though, a high number of director's post make

boards ‘too busy’ to control and take initiatives re risk taking. Furthermore, given the recent focus on the issues of board structure both in academia and amongst policymakers, our results are timely and add to the argument on the benefits and costs of these board of directors' features. Concerning the R&D and risk management field, this study suggests advice to managers and policymakers about the selection procedure of board members who can have an important effect on risk taking measured by R&D intensity. Lastly, our results highlight the need for the deliberation of both agency theory and resource dependence theory so as to advance theoretical frameworks that can better elucidate the role of board of directors in risk taking literature.

Despite the contributions presented above, this research has potential limitations that should be taken into consideration. The first possible limitation is associated with the sample. This research depends only on companies listed in Forbes Global 2000. This study offers new possibilities for future research in a number of ways. First, future studies may consider other markets such as China and India. Another avenue would be to use other measures of risk-taking. Finally collecting primary data such as interviews may enrich future research.

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Tables

Table 1 Variables definition and measurement

CG variable (Board Structure)	
Board Size	The total number of directors on the board at the end of financial year
Frequency of Board Meetings	A binary number of one if a firm's board of directors meets at least four times in a financial year, and zero otherwise.
Risk-Taking	
R&D/Sales	Natural logarithm of R&D expenditure /total sales
Control variables	
Sales Growth	(Current year's sales- Previous year's sales) /previous year's sales
Firm Size	Natural logarithm of the book value of total assets
Audit Committee	Number of Audit Committee
Corporate Governance Committee	Number of CG Committee
Leverage	Total debt /Total assets
Corruption Index	The misuse of public power for private benefit
Inflation	The average of general level of prices for goods and services is rising
Gross domestic product per Capita	GDP/ # of people living in the country
Population	Number of People living
Power Distance	The degree to which the less powerful members of a society accept and expect that power is distributed unequally

Table 2 Summary descriptive statistics of the dependent and independent variables

Variables	Mean	Median	Std, Deviation	Minimum	Maximum
Independent (Corporate governance (CG)/Board characteristics) variable					
BS	12.23	12	3.41	5	22
FBM	8.08	17.5	3.957	0	35
Dependent Variable (Risk-Taking)					
R&D/Sales	.045	.0235	.096	.000029	1.09446

Table 3 Pearson's and Spearman's correlation matrices of the variables

Variable	*BS*	*FBM*	*SG*	*FS*	*AC NO*	*CGC NO*	*CORR IDX*	*INFL*	*POP*	*LVG*	*ANG*	*GDPC*	*POWD*
BS	1	-.133	-.082	.445	.303	.246	-.130	-.333	.279	.258	.222	-.165	.111
FBM	-.081	1	.726	-.116	.029	.081**	.119***	-.054	.075	-.069**	.212***	.141***	-.103***
SG	-.086	-.070	1	-118***	-.108***	-.475	.087	.056	-.094	-.085***	.085	.814	-.068*
FS	.442	.056*	-.111***	1	.365***	.335***	.074	.074	-.087	.209***	-.153***	-.066	.322***
AC NO	.289	.091***	-.105***	.308***	1	.267***	.324***	.091**	.187***	.111***	.063	.117***	-.072
CGC	.230	.059**	-.098	.224***	.187***	1	.299***	-.139***	-.097***	.056	.357***	.328***	-.375***
CORR IDX	-.88	.194***	.194***	-.069*	.322***	.421***	1	.149***	-.246***	-.174***	.499***	.619***	-.417***
INFL	-.118	.065*	.058*	-.847	.082	-.154*	.189***	1	.333	-.085	-.092***	-.062*	.109***
POP	.301	-.086	-.109***	.234***	.189***	-.092***	-.309***	-.084**	1	.159***	-.421***	-.491***	.519***
LVG	.266	-.076**	-.105***	.191***	.103***	.147	-.193***	-.066	.165***	1	-.155***	-.221***	.084**
ANG	-.118	.259***	.087*	-.142***	.094*	.347***	.513***	.104***	-.438***	-.186***	1	.685***	-.733***
GDPC	-.179	.223***	.085*	-.063**	.118***	.327***	.673***	-.097	-.491***	-.232***	.724***	1	-.586***
POWD	.094	-.123***	-.089***	.189***	-.745	-.345***	-.529***	.325	.506***	.068**	-.634***	-.517***	1

*Notes: the bottom left half of the table presents Pearson's parametric correlation coefficients, whilst the upper right half of the table presents Spearman's non-parametric correlation coefficients. ** and * denote correlation is significant at the 1% and 5% level, respectively. Variables are defined as follows: Board Size (BS), Frequencies of Board Meeting (FBM), Growth (SG), Firm Size (FS), Sales, Audit Committee No. (AC), Corporate Governance Committee No. (CGC NO), Corruption Index (CORR IDX), Inflation (INFL), Population (POP), Leverage (LVG), Anglo American (ANG), GDP per Capita (GDPC) and Power Distance (POWER D).*

Table 4: OLS Regression Results of Frequency of Board Meetings on R&D Intensity

	All firm years	2010	2011	2012	2013	2014	VIF
Adjusted R^2	.182	.125	.119	.109	.194	.231	-
Standard Error	.716	.679	.736	.764	.741	.714	-
Durbin- Watson	.553***	2.131	1.942	2.061	2.206	1.831	-
F-Value	.571	1.66*	1.646*	1.623*	2.242***	2.385***	-
No. of Observations	504	97	99	105	107	96	-
Constant	-3.426***	-2.409**	-1.827*	-1.129	.146	-1.706*	-
Independent Variables							
Board Size	-2.481**	-2.021**	-2.270**	-1.131	-1.366	-1.539	2.56
Frequency of Board Meetings	-4.286***	-.371	-2.768***	-1.713*	-1.722*	-2.655***	3.045
Control Variables							
Firm Size	-2.079**	-1.175	-.939	-.676	-.313	-.655	2.462
Sales Growth	.362	-.144	-.118	.528	-.863	.554	1.071
Audit Committee No.	-1.624*	-.013	-1.324	-1.154	-2.281**	-.053	1.367
CG Committee No.	5.126***	2.255**	1.866*	1.968*	2.794***	3.013***	1.210
Leverage	.585	.298	1.535	-.057	-.372	.393	1.307
Corruption Index	2.005**	-1.309	.289	1.261	-.242	2.985***	1.1885
Inflation	-.783	1.864*	-1.087	-.866	-3.215***	-.206	1.132
GDP Per Capita	.753	2.973***	.325	-1.232	-.257	.316	1.209
Population	1.547	2.016**	.508	-.509	-.355	2.466**	2.439
Power Distance	3.493***	-1.426	.981	1.395	-.315	2.009**	1.452
Anglo American	4.578***	-2.249**	-.258	.188	-1.714*	-1.264	5.145
2010	1.217	-	-	-	-	-	0.211
2011	.564	-	-	-	-	-	0.406
2012	.414	-	-	-	-	-	0.542
2014	-.513	-	-	-	-	-	0.015

*Notes: coefficients are in front of parenthesis. ***, ** and * denote p-value is significant at the 1%, 5% and 10% level, respectively. Also, year 2013 are excluded from the regression analyses. It is used as base year, respectively, for purposes of comparison.*