



BOARD DIVERSITY ATTRIBUTES AND RISK-TAKING: CONTINGENCY FRAMEWORK OF EARLY ADOPTED GENDER QUOTA

*Atributos de Diversidade do Conselho e Assunção de Riscos: Estrutura de Contingência da Cota de Gênero
Adotada Antecipadamente*

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ABSTRACT

While countries that early adopted mandatory quota exhibit a marked acceleration in women's representation on boards, it is noticed that boards also alternatively enlarged by the additive approach. Gender diversity and board size have been jointly analyzed in this study since their interplay is suggested by literature as triggers for gender equality during implementation of quota in early stages. This research investigates the relationship between the two boards' diversity attributes and corporate risk on selected industries and countries, over 4 years between 2020-2023. Standard deviation with a 5-years overlapping windows is one of the main proxies for risk in finance since it captures the degree of firm's risk-taking through the volatility of indicators like debt-to-equity sd(DE), return on assets sd(ROA) and operating efficiency sd(OpR), underlying the assumption that riskier corporate operations lead to greater volatility. Using linear regression estimates we find that board gender diversity has a positive influence on the volatility of returns sd(ROA), while board size is positively influencing the operating ratio volatility sd(OpR) on the contingency framework of mandatory quota. Our results support the intergroup contact theory suggesting that women borrow the risk-attitude from their man board-counterparts in their professional roles.

Keywords: Board gender diversity, Board size, Standard deviation, Corporate risk, Mandatory quota

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ATRIBUTOS DE DIVERSIDADE DO CONSELHO E ASSUNÇÃO DE RISCOS: ESTRUTURA DE CONTINGÊNCIA DA COTA DE GÊNERO ADOTADA ANTECIPADAMENTE

Board Diversity Attributes and Risk-taking: Contingency Framework of Early Adopted Gender Quota

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RESUMO

Embora os países que adotaram cotas obrigatórias precocemente apresentem uma aceleração acentuada na representação feminina nos conselhos, observa-se que os conselhos também foram ampliados alternativamente pela abordagem aditiva. A diversidade de gênero e o tamanho do conselho foram analisados conjuntamente neste estudo, uma vez que sua interação é sugerida pela literatura como gatilhos para a igualdade de gênero durante a implementação de cotas em estágios iniciais. Esta pesquisa investiga a relação entre os dois atributos de diversidade dos conselhos e o risco corporativo em setores e países selecionados, ao longo de 4 anos entre 2020-2023. O desvio padrão com janelas sobrepostas de 5 anos é um dos principais proxies para risco em finanças, uma vez que captura o grau de tomada de risco da empresa por meio da volatilidade de indicadores como dívida/patrimônio líquido (DP), retorno sobre ativos (ROA) e eficiência operacional (OPR), fundamentando a suposição de que operações corporativas mais arriscadas levam a maior volatilidade. Utilizando estimativas de regressão linear, constatamos que a diversidade de gênero no conselho de administração influencia positivamente a volatilidade dos retornos (DP(ROA)), enquanto o tamanho do conselho influencia positivamente a volatilidade do índice operacional (DP(OpR)) na estrutura de contingência da cota obrigatória. Nossos resultados corroboram a teoria do contato intergrupar, sugerindo que as mulheres adotam a atitude de risco de seus colegas homens no conselho em suas funções profissionais.

Palavras-chave: Diversidade de gênero no conselho, Tamanho do conselho, Desvio padrão, Risco corporativo, Cota obrigatória

INTRODUCTION

Initially framed as a social concern and a matter of public reputation-shaped by perceptions and stereotypes about women-the academic focus has gradually shifted from exploring the inherent differences between men and women (biological, psychological, cultural, or societal) to investigating how gender diversity on corporate boards affects organizational outcomes. Board-level diversity, as a characteristic of the highest decision-making body within corporations, has become a key topic of interest in social, institutional, and academic discourse, growing in significance over time.

Why does gender matter? Why should women be promoted into influential board roles?

The presence of women on corporate boards is increasingly supported by evidence of their positive impact on firm performance. Gender-diverse boards are associated with enhanced value creation by introducing broader, fresher, and more diverse perspectives into decision-making processes. (Carter et al., 2007) argue that heterogeneity in human capital among board members enhances board independence, thereby strengthening the board's ability to effectively monitor management. As noted by (Terjesen & Sealy, 2016), the representation of women on boards is now seen as a value driver, prompting both social and regulatory pressures on companies to increase female participation in leadership roles. (Gupta et al., 2020) demonstrate that gender diversity strengthens corporate governance by improving disclosure practices and reducing financial misreporting. Likewise, (Adams & Ferreira, 2009) find that female board members attend more meetings, implying a higher level of oversight and, potentially, improved performance outcomes.

The role of institutional frameworks and regulations in promoting gender equality has also received substantial attention, especially with the implementation of gender quota laws in early-adopter countries such as those in the Nordic region. (Seierstad, 2011) shows that the proportion of women directors on boards significantly increased during the quota implementation period, particularly as compliance deadlines approached. However, (Seierstad & Opsahl, 2011) also identify an unintended consequence: the rise of "golden skirts," or a concentration of board memberships among a few women, signaling superficial compliance without genuine structural change in leadership dynamics.

Offering a different perspective (Ahern & Dittmar, 2012) provide empirical evidence that the announcement of Norway's quota law led to a notable drop in stock prices and a decline in firm value. They argue that firms complied through an "additive strategy"-simply increasing the number of board seats to accommodate women without altering board dynamics. (Matsa & Miller, 2013) similarly question how corporate strategies and outcomes might shift with more women in senior leadership, noting short-term profit declines in Nordic countries but suggesting that the effects of quotas may be more pronounced in societies with more traditional gendered roles or lower commitments to equality.

Critical mass theory is also central to the discussion. Research shows that the impact of women on boards increases with their numbers. (Brahma et al., 2021) find that the critical mass of women, along with age and education levels, positively correlates with firm performance. (Fondas & Sassalos, 2000) suggest that women's influence on decision-making grows when more than one woman serves on a board. (Konrad & Kramer, 2006) argue that while one woman can contribute meaningfully and two can improve dynamics, boards with at least three women benefit most. (Torchia et al., 2011) confirm that this transition-from token representation to a consistent minority-enhances firm innovation. (Simionescu et al., 2021) add that there is a maximum limit, but minimum one female participation within the board that positively affects the financial performance of IT companies. Supporting this, (Zaccone & Argiolas, 2024) find that a critical mass of women on boards is linked to better performance in countries with weaker gender equality norms. Similarly, (Alsahali, 2025) emphasizes that a critical mass is necessary for women's board representation to influence firms' assurance of sustainability reporting, especially in low-equality contexts.

In a cross-country analysis, (Terjesen et al., 2016) assess the role of both the presence and independence of women directors on market performance and return on assets (ROA), concluding that presence itself matters more than formal independence. This supports the idea that both gender diversity and board size-factors often linked through additive strategies-may influence corporate outcomes.

While most existing studies focus on financial performance metrics, less clarity has been given to board dynamics related to gender diversity and their implications for corporate risk-taking-a key corporate outcome. Risk-taking, a broad and integral element of strategic decision-making, may benefit from diverse board member

backgrounds (Saeed et al., 2016). (Adams & Ferreira, 2009) also argue that diverse boards enhance value creation and productivity due to women's greater oversight skills. However, empirical findings on the relationship between board diversity and corporate risk remain inconclusive. Whereas some studies-such as (Chen et al., 2017) and (Levi et al., 2014) report a negative correlation between female board presence and risk-taking, others, like (Adams & Funk, 2012) and (Berger et al., 2014), find a positive relationship.

This inconclusiveness suggests that additional organizational factors-beyond gender representation alone-may moderate or mediate the relationship between board diversity and corporate risk. To explore this further, we adopt a contingency perspective and analyze *companies* operating in European countries that implemented gender quota in its early stages and *industries* known for their high-performance volatility. Specifically, we investigate how relation-oriented board attributes (such as gender) and structural attributes (such as board size) influence corporate risk in the context of additive strategies used to meet quota requirements.

This study contributes to literature in two ways. First, while prior studies primarily assess financial risk using metrics such as leverage or return on assets, we introduce operating ratio (OpR) volatility as an additional proxy for corporate risk. Second, our empirical analysis is focused on early-adopter countries with mandatory quotas, where gender diversity is expected to have a significant influence. In line with the literature, we classify board attributes into relation-oriented factors (e.g., age, gender, ethnicity) and task-oriented factors (e.g., tenure, expertise, independence, oversight). Board size, firm size, and leverage are treated often as control variables ((Bernile et al., 2018); (Bhat et al., 2019); (Harjoto et al., 2018); (Jebran et al., 2020)). However, in this study, we propose that both gender diversity and board size-when viewed through the lens of a contingency framework shaped by additive compliance strategies-may have a direct impact on corporate risk-taking.

The remainder of the paper is organized as follows. In the *Literature review* section, we selected a few studies relevant for the topic of board diversity attributes and corporate risk, to support our hypothesis, followed by the description of the data and quantitative analysis in the *Methodology* section. In the last section *Results and discussions*, we outline our results and conclusions.

1 LITERATURE REVIEW

1.1 Theoretical background

Agency theory is one of the most prominent frameworks employed to examine board diversity, shaping much of the existing literature on the topic. From the perspective of *agency theory*, board members act as agents in a contractual relationship with shareholders, who are regarded as principals and the ultimate providers of financial capital to the firm (Jensen & Meckling, 1976). Shareholders delegate decision-making authority to the board, entrusting it with the responsibility to act in their best interests. However, this delegation gives rise to what is commonly referred to as the agency problem-a potential misalignment of interests between the agent and the principal, as both parties are assumed to be rational, utility-maximizing individuals (Eisenhardt, 1989). In such cases, board members may prioritize personal goals over shareholder welfare, especially when the two are in conflict.

This fundamental challenge has led to a growing interest in the characteristics of the board, including diversity, and their influence on aligning managerial decisions with shareholder interests. (Kang et al., 2007) define board diversity as the “variety in the composition of the board of directors.” Agency theory rests on three core human behavioral assumptions: self-interest, bounded rationality due to limited information, and risk aversion (Eisenhardt, 1989).

Notably, early research connects these behavioral assumptions to psychological and socio-demographic characteristics, particularly gender. Studies have shown that women psychological traits are strongly associated with risk but not to ambiguity, thereby influencing the risk preferences of the board as a whole (Borghans et al., 2009). Additionally, agency theory acknowledges that information asymmetry exists-agents typically have more information than principals, which affects how risk-related decisions are made. Given this dynamic, diversity in board attributes may influence not only risk preferences between shareholders and directors, but also among directors themselves. Thus, examining board diversity is essential for understanding its role in shaping corporate risk-taking behavior.

The *resource-based theory* (RBT) is an influential approach in strategic management. It has been widely applied as a managerial framework to determine vital resources for a firm to achieve a sustained competitive advantage. The theory provides an essential framework to explain and predict the fundamentals of a company's performance and competitive advantage- mainly *endogenous* factors- having its roots in the seminal work of (Barney, 1991) about strategic resources. Board diversity facilitates members to provide resources such as qualifications, skills, experiences, characteristics, knowledge, legitimacy, information, and access to key connections. Therefore, heterogeneous boards are assumed to provide diverse resources in terms of different perspectives and insights, which can lead to better understanding and solving of the problems, making decisions as well as implementing strategies (Carter et al., 2007).

In the context of board attributes, the *Upper Echelons Theory* (Hambrick & Mason, 1984) offers an important complementary perspective. This theory posits that organizational outcomes-specifically strategic choices and performance-are largely shaped by the background characteristics and personal interpretations of top executives. These interpretations are themselves shaped by executives' individual experiences, values, and personalities (Hambrick, 2007). Initially developed to examine the influence of CEO characteristics on firm outcomes, the theory has since been extended to encompass broader executive teams, including the board of directors. This expansion is based on the premise that decision-making power is often distributed among senior executives, rather than concentrated solely in the CEO. As such, the board and other top management team members jointly influence strategic direction and performance. Upper Echelons Theory thus asserts that each executive's input contributes meaningfully to corporate outcomes, reinforcing the value of analysing board-level diversity. The theory places particular emphasis on observable demographic and professional attributes-such as age, tenure, educational background, professional experience, socioeconomic origin, and financial position-which are often used as proxies for more complex psychological or cognitive traits. These characteristics are not only more readily measurable but also serve as indicators of how individuals perceive and respond to strategic challenges. Therefore, understanding board diversity through the lens of Upper Echelons Theory enhances our ability to predict how heterogeneous executive teams might shape firm behaviour and performance.

1.2 Previous research and hypothesis development

Recent research has highlighted the potential role of board composition in tempering agency risks in organizations. (Gupta et al., 2020) finds that board gender diversity plays a significant role in enhancing corporate governance.

1.3 Board size

Adams et al. (2010) identify board size, independence, and CEO power as key factors in mitigating agency problems within organizations. Similarly, (Belghitar & Clark, 2015) emphasize that monitoring mechanisms such as board composition and size play a critical role in reducing agency costs, particularly in large firms. From the perspective of resource-based theory, the number of directors on a corporate board can influence decision-making dynamics and overall organizational outcomes. Smaller boards are often perceived as more effective, primarily due to fewer communication and coordination challenges, which may enhance efficiency (Jensen, 1993). Empirical research supports this view, indicating that firms with smaller boards tend to exhibit superior corporate performance compared to those with larger boards.

However, while larger boards may offer greater diversity in expertise and broader human capital, their benefits may be outweighed by increased complexity and slower decision-making processes (De Andres et al., 2005). The coordination burdens and difficulties in reaching consensus often associated with larger boards can impede timely and decisive strategic action. In this regard (Cheng, 2008) suggests that firms with larger boards may engage in less risk-taking, owing to the cautious nature of group-based decision-making. This finding is reinforced by research in economics and social psychology, which argues that decisions made by larger groups tend to reflect a compromise among diverse viewpoints rather than bold or extreme strategies. (Eisenberg et al., 1998) also highlights that communication inefficiencies in larger boards contribute to delays in critical decisions. Further supporting this perspective (McNulty et al., 2013) reports a negative relationship between board size and financial risk in their sample of UK firms.

Considering these arguments, a negative relation between **board size** and risk-taking is expected, thus we predict,

H1a: There is a negative relationship between board size and corporate risk, measured as standard deviation of Financial Leverage (sdD/E)

H1b: There is a negative relationship between board size and corporate risk, measured as standard deviation of Return of Assets (sdROA)

H1c: There is a negative relationship between board size and corporate risk, measured as standard deviation of Operating Ratio (sdOpR)

1.4 Board Gender Diversity

Findings from social psychology support the notion that diversity tends to result in more moderated and balanced decision-making (Kogan & Wallach, 1964). In recognition of its potential benefits, many countries have enacted legislation mandating the inclusion of female directors on corporate boards (Smith, 2018). Among the various dimensions of board diversity, gender diversity is widely regarded as one of the most significant (Anderson et al., 2011; Carter et al., 2003). Nonetheless, board diversity encompasses a broader set of characteristics, including age, tenure, professional background, and educational attainment.

Empirical research in both economics and psychology consistently shows that women tend to be more risk-averse than men (Sila et al., 2016). Furthermore, management literature has identified key behavioral and psychological distinctions between male and female leaders, with implications for decision-making processes and governance practices. While diverse boards are generally associated with enhanced capacity to understand and respond to complex and uncertain environments—thereby improving risk management—there are also potential trade-offs. Specifically, heterogeneity within the board or top management team may slow down the decision-making process due to differences in perspectives, values, and communication styles. Thus, while diversity can enrich deliberation and oversight, it may also introduce challenges in reaching timely consensus. Increasing the representation of women on boards often influences board dynamics, although may, in some cases, lead to an expansion in board size.

Given that women generally exhibit lower risk tolerance than men (Croson & Gneezy, 2009), if female board members share similar behavioral traits with the broader female population, gender diversity at the board level may be associated with reduced corporate risk-taking. Supporting this view, (Palvia et al., 2015) found that female directors demonstrate greater risk aversion compared to their male counterparts. This behavioral tendency has measurable effects on firm-level outcomes. Using a large sample of European privately listed firms, (Faccio et al., 2016) found that companies led by female CEOs tend to have lower financial leverage and more stable earnings, indicating a more cautious approach to financial decision-making. In a related study, (Bernile et al., 2018), analyzing a sample of U.S. firms, observed a negative relationship between board diversity and firm risk. They argue that more diverse boards are better equipped to manage risk through strategic innovation, particularly via increased investment in research and development (R&D). These findings suggest that gender diversity may influence not only the level of risk undertaken by firms but also the mechanisms through which firms approach risk mitigation.

Contrary to the commonly held view that women are universally more risk-averse, some studies offer more nuanced findings. (Saeed et al., 2016) argue that women employed in high-technology firms tend to exhibit greater risk-taking behavior compared to their counterparts in low-tech industries. Similarly, (Adams & Funk, 2012) present evidence that women directors may, in certain contexts, make riskier decisions than male directors—decisions that can, in some cases, adversely affect profitability and firm value. (Berger et al., 2014) also report a positive relationship between the proportion of women on corporate boards and the level of risk-taking.

In contrast, other studies challenge the existence of a clear line between gender diversity and corporate risk behavior. (Loukil & Yousfi, 2014) find no statistically significant relationship between board gender diversity and the likelihood of engaging in either strategic or financial risk-taking. Furthermore, (Maxfield et al., 2010) caution against stereotypical assumptions about female risk aversion, noting that such labels may not only misrepresent actual behavior but also reversely discourage women from embracing appropriate levels of risk, thereby limiting potential benefits for both individuals and organizations.

Taken together, these findings reveal a mixed and context-dependent relationship between board gender diversity and corporate risk-taking. Nevertheless, what remains consistent throughout literature is the board's critical role in shaping a firm's risk profile, whether through direct oversight or by influencing the strategic posture of the organization.

Hence, we predict that the **board gender diversity** is a negative predictor of the corporate risk,

H2a: There is a negative effect of board gender diversity on corporate risk measured as standard deviation of Financial Leverage (sdD/E)

H2b: There is a negative effect of board gender diversity on corporate risk measured as standard deviation of Return of Assets (sdROA)

H2c: There is a negative effect of board gender diversity on corporate risk measured as standard deviation of Operating Ratio (sdOpR)

2 SAMPLE AND METHODOLOGY

This study employs a quantitative research design, utilizing comprehensive firm-level data retrieved from LSEG Workspace (Refinitiv Eikon) for all variables under analysis. Based on prior research concerning mandatory gender quotas, we focus on six European countries that were early adopters of legally binding gender quota legislation. We examine how relationship-oriented board attributes-specifically gender diversity and board size-affect corporate risk-taking, using the most recent publicly available data (YE, 2023). The study is framed within a contingency approach, considering the interaction between institutional contexts (mandatory quotas) and industry-specific characteristics over the four-year period from 2020 to 2023. Risk is measured using a five-year rolling window extending back to 2016.

Empirical analysis employs both pooled linear regression models (OLS) and panel data models with firm-year fixed effects (FE) and random effects (RE) models to estimate the relationship between board attributes and corporate risk, while also testing for potential non-linear effects of gender diversity. In the case of random effects models, the selection of the appropriate specification was guided by the Hausman test, which determines whether fixed or random effects provide a more consistent estimation of the coefficients.

The final sample comprises 735 listed companies, identified using Refinitiv's RIC codes, from six countries and five industry sectors (classified by TRBC Economic Sector Name) considered to be highly sensitive to management-driven volatility (**Table 1**). The total number of firm-year observations ranges from 925 to 2,707. All statistical analyses-including descriptive statistics, correlation matrices, regression estimations, and diagnostic tests-were conducted using Stata. Dependent, independent and control variables in our study are detailed in (**Table 2**).

Table 1 - Sample description

Panel A	735	Panel B	735
Belgium	33	Consumer Cyclical	217
France	252	Consumer non-cyclical	7
Germany	235	Energy	56
Iceland	3	Healthcare	187
Italy	126	Technology	268
Norway	86		

Source: Author's own work

Table 2 - Variable description

Variable	Acronim	Definition	Formula
Risk Variables			
Financial Leverage Volatility	sdD/E	Proportion of debt and equity used to finance the company assets	$D/E = \text{Total Debt} / \text{Total Equity} (\%)$
Returns Volatility	sdROA	Company returns over Total Assets	$ROA = \text{Net Income} / \text{Total Assets} (\%)$
Operating Ratio Volatility	sdOpR	Measure of a company operational risk profile	$OpR = \text{Operating Expenses} / \text{Total Sales} (\%)$
Board Attributes Variables			
Board Gender Diversity	Bgd	Percentage of women in total board members	$Bdg = \text{No of Women} / \text{Total Board Members} (\%)$

Board Size	Bsz	Number of directors having a seat on board	Sum of board members
Firm Variables			
Total Assets	lnTA	Sum of the book value of all assets own by the firm	lnTA = log (TA)
Firm Age	cAge	Total years of activity since incorporation	cAge = current year - incorporation year

Source: financial literature/ author's own work

Grounded in the institutional implications of quota policies, we hypothesize that the presence of women on boards may be associated with increased board size, reflecting an additive approach to board expansion. Therefore, both gender diversity and board size are analyzed as key explanatory variables. To measure firm risk, we use three dependent variables: the standard deviation of the debt-to-equity ratio (sdD/E), the standard deviation of return on assets (sdROA), and a newly introduced measure, the standard deviation of operating return (sdOpR). To control for firm-level characteristics, we include firm size, measured as the natural logarithm of total assets (lnTA), and firm age, defined as the number of years since incorporation (cAge). To mitigate the influence of outliers, particularly relevant in the context of an unbalanced panel, all variables are winsorized at the 10th and 90th percentiles. Our empirical results are derived from a series of regression models constructed specifically for this research. These include linear models without and with fixed and random effects.

The general form of the regression model used in the analysis is as follows:

$$Risk_{it} = \beta_0 + \beta_1 BoardGenderDiversity_{it} + \beta_2 BoardSize_{it} + \sum \beta_{it} Firm_{it} + \varepsilon_{it}$$

Were:

$Risk_{it}$ = dependent variable

β_0 = constant

$\beta_{1,2}$ = coefficients corresponding to relation-oriented board attributes variable

β_{it} = coefficients corresponding to firm related attributes control variable

ε_{it} = error term

i = [1, 735]

t = [2020, 2023]

Corporate risk $Risk_{it}$ is operationalized using three proxies, each reflecting the standard deviation of three key financial outcomes: Financial Leverage (measured as Total Debt divided by Total Equity, %), Return on Assets (ROA, defined as Net Income over Total Assets, %), and Operating Ratio (OpR, %), the latter being a construct developed by the authors based on financial literacy indicators. The Operating Ratio is calculated as Total Operating Expenses divided by Net Sales, with both components obtained from the same Refinitiv data source.

To capture the volatility associated with these outcomes, standard deviations were calculated using a five-year overlapping window, a commonly adopted method in empirical risk research. Based on this approach, we estimate three distinct regression models-each corresponding to one of the proposed risk proxies. Each model is run in two forms: one including and one excluding the squared term of board gender diversity (sqBgd) to assess potential non-linear effects of gender. This modeling strategy allows for a more nuanced understanding of the relationship between board composition and firm-level risk-taking behavior.

$$sdDE_{it} = \beta_0 + \beta_1 Bgd_{it} + \beta_2 Bsz_{it} + \sum \beta_{it} Firm_{it} + \varepsilon_{it} \quad (1)$$

$$sdDE_{it} = \beta_0 + \beta_1 Bgd_{it} + \beta_2 Bsz_{it} + \beta_3 sqBgd_{it} + \sum \beta_{it} Firm_{it} + \varepsilon_{it} \quad (2)$$

$$sdROA_{it} = \beta_0 + \beta_1 Bgd_{it} + \beta_2 Bsz_{it} + \sum \beta_{it} Firm_{it} + \varepsilon_{it} \quad (3)$$

$$sdROA_{it} = \beta_0 + \beta_1 Bgd_{it} + \beta_2 Bsz_{it} + \beta_3 sqBgd_{it} + \sum \beta_{it} Firm_{it} + \varepsilon_{it} \quad (4)$$

$$sdOpR_{it} = \beta_0 + \beta_1 Bgd_{it} + \beta_2 Bsz_{it} + \sum \beta_{it} Firm_{it} + \varepsilon_{it} \quad (5)$$

$$sdOpR_{it} = \beta_0 + \beta_1 Bgd_{it} + \beta_2 Bsz_{it} + \beta_3 sqBgd_{it} + \sum \beta_{it} Firm_{it} + \varepsilon_{it} \quad (6)$$

Table 3. presents the descriptive statistics for the variables used in the empirical analysis, considering the number of valid observations reported. The average board size across the sample is 9 members, with values ranging from a minimum of 4 to a maximum of 15 directors. On average, women represent 35% of board composition, with a minimum representation of 10% and a maximum of 50%. Firm size, measured by total assets, reflects a relatively homogeneous distribution across the sample, resulting from the highest number of observations recorded (2,707). Company age varies between 4 and 46 years, and when considered alongside firm size, this suggests that various industries benefit from significantly better market conditions, thus, fast grow opportunities. Regarding corporate risk, the volatility of the proposed proxies is notably high relative to their respective means. Financial leverage exhibits a volatility of 51%, while the operating ratio shows a 65% standard deviation-both indicating significant heterogeneity across firms. These differences may be attributed to variations in business models and strategic choices, particularly in capital structure (debt vs. equity financing) and operational management (cost versus revenue efficiency). Return on Assets (ROA) also shows considerable variation, with an average of 7% and a range spanning from 1% to 22%, further reflecting diversity in firm performance and risk exposure across the sample.

Table 3 - Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Bsz_w	925	9.061622	3.618957	4	15
Bgd_w	925	35.62496	12.55734	10	50
lnTA_w	2707	18.89531	1.890713	16.2793	22.0591
cAge_w	2548	21.36068	12.80777	4	46
sdDE_w	2636	.4364158	.5167996	.0247503	1.651212
sdROA_w	2642	.0753913	.0692119	.0117652	.2269019
sdOpR_w	2617	.3610437	.6544476	.0133988	2.114956
N	2910				

Source: Author's own work

To assess potential multicollinearity among the independent and control variables, we examined the correlation matrix, focusing on coefficients exceeding +/- 0.7. As is presented in (**Table 4.**), no pairwise correlations surpass this threshold, suggesting that multicollinearity is not a concern and that all variables may be included within the same regression models without structural distortion. Nonetheless, a few variable pairs exhibit moderate correlations above 0.5, notably between total assets (TA) and board size (Bsz), and between the standard deviation of ROA (sdROA) and the standard deviation of the operating ratio (sdOpR). These associations are theoretically plausible. Firms with larger asset bases are often characterized by greater organizational complexity, which may necessitate larger boards. Similarly, fluctuations in operating ratios-driven by changes in either expenses or in sales-can influence earnings volatility, thereby contributing to higher ROA variability. While these relationships are not strong enough to warrant exclusion or separation in the modelling strategy, they offer meaningful insights into the underlying firm dynamics.

Table 4 - Correlation matrix

Variables	Bsz_w	Bgd_w	lnTA_w	cAge_w	sdDE_w	sdROA_w	sdOpR_w
Bsz_w	1						
Bgd_w	0.388***	1					
lnTA_w	0.646***	0.352***	1				
cAge_w	0.391***	0.264***	0.242***	1			
sdDE_w	-0.0600	-0.0329	-0.106***	-0.109***	1		
sdROA_w	-0.192***	0.0447	-0.453***	-0.218***	0.160***	1	
sdOpR_w	-0.111***	0.0689*	-0.343***	-0.235***	0.0496*	0.637***	1

t statistics in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Author's own work

3 RESULTS AND DISCUSSIONS

To test our hypotheses, we employed both pooled linear regression models (OLS) and panel data models with fixed effects (FE) and random effects (RE). These models were estimated separately for each of the three proxies used to measure corporate risk: the standard deviation of the debt-to-equity ratio (sdD/E), return on assets (sdROA), and the operating ratio (sdOpR).

The *regression results without effects* are summarized in (**Table 5.**) Columns (1) and (2) present results where sdD/E is the dependent variable. Columns (3) and (4) report findings for models using sdROA, while columns (5) and (6) detail those with sdOpR as the outcome variable. For each dependant variable, the second specification includes a squared term for board gender diversity (sqBgd_w) to capture potential non-linear effects of gender diversity on corporate risk, as suggested in parts of the literature discussing the critical mass. Each equation result is presented in corresponding column.

Table 5 - Results of regression models without effects

Dependent Variables	(1) sdDE_	(2) sdDE	(3) sdROA	(4) sdROA	(5) sdOpR	(6) sdOpR
Independent Variables						
Bsz_w	-0.0073 (-1.1954)	-0.0070 (-1.1391)	0.0003 (0.5462)	0.0003 (0.4793)	0.0237*** (4.2266)	0.0245*** (4.3115)
Bgd_w	0.0007 (0.5008)	-0.0013 (-0.1968)	0.0008*** (5.8820)	0.0011* (1.6879)	0.0079*** (6.1590)	0.0027 (0.4394)
lnTA_w	0.0192 (1.1769)	0.0191 (1.1701)	-0.0152*** (-9.6691)	-0.0152*** (-9.6616)	-0.1805*** (-12.1995)	-0.1806*** (-12.2046)
cAge_w	-0.0034*** (-2.6197)	-0.0034*** (-2.6324)	-0.0002* (-1.7577)	-0.0002* (-1.7264)	-0.0037*** (-3.1071)	-0.0038*** (-3.1624)
sqBgd_w		0.0000 (0.3110)		-0.0000 (-0.4488)		0.0001 (0.8823)
_cons	0.0973 (0.3198)	0.1224 (0.3886)	0.3354*** (11.4610)	0.3321*** (10.9880)	3.5111*** (12.7274)	3.5730*** (12.5502)
F statistic	2.7121**	2.1866*	37.9134***	30.3402***	46.9128***	37.6751***
R-sq	0.0136	0.0138	0.1616	0.1618	0.1953	0.1961
Obs	789.0000	789.0000	792.0000	792.0000	778.0000	778.0000

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source: own estimates

Our results show that company age exerts a statistically significant negative effect (-0.34%), on corporate risk measured as the volatility of the leverage ratio (sdD/E), with significance at the 1% level. However, the main variables of interest-board gender diversity and board size-do not exhibit statistically significant effects on financial leverage volatility in this specification. To examine potential non-linear effects, different model includes the squared term for gender diversity (sqBgd), but as shown in column (2), this addition does not add better statistically significant results. Robustness checks using fixed effects models for the relationship between board attributes and sdD/E produced similarly non-significant results.

Consequently, hypotheses H1a and H2a, which posit a negative relationship between board diversity and corporate risk measured as financial leverage volatility, are not supported.

In contrast, when corporate risk is measured by the standard deviation of return on assets (sdROA), we observe a positive and statistically significant effect of gender diversity (0.08%) at the 1% level, as reported in column (3). This suggests that higher female representation on boards may increase earnings volatility, potentially reflecting riskier revenue-enhancing strategies pursued by women directors. These findings are consistent with (Saeed at al., 2016), who argue that women in high-tech firms exhibit higher risk-taking behaviour than those in other sectors. Although board size also shows a positive coefficient, its effect is not statistically significant. Test for a non-linear relationship using the squared gender diversity term in column (4), does not add significant results. However, firm size, measured as the natural logarithm of total assets, shows a significant negative effect on sdROA,

indicating that smaller firms experience greater return volatility. Despite these insights, we find that effects of board diversity (gender and board size) on sdROA is positive and statistically significant, yet inconsistent when alternative specification (random effect models show a negative correlation between board size and corporate risk), therefore hypotheses H1b and H2b are not supported.

Finally, column (5) exhibits corporate risk as the standard deviation of the operating ratio (sdOpR) to which both gender diversity and board size have a positive effect on this measure of risk, with board size significance at the 1% level. This result suggests that larger, more gender-diverse boards are associated with increased volatility in operational efficiency. However, when testing for non-linear effects as shown in column (6), the squared gender diversity term remains positive and statistically insignificant. These findings diverge from previous literature, such as (Cheng, 2008), which argues that larger boards tend to favour consensus-based, lower-risk decisions. Instead, our results indicate that gender-diverse and larger boards may adopt more aggressive or innovative strategies, potentially increasing operational risk. Nevertheless, the lack of consistency across all models means that hypotheses H1c and H2c cannot be also confirmed.

To verify for the robustness of our findings, we conducted additional analyses using *fixed and random effects regression models*, with the results presented in (**Table 6.**). The choice between fixed and random effects was determined using the Hausman test. When the test returned a p-value (Prob > chi2) below 0.05, fixed effects were preferred; otherwise, random effects were retained. Consistent with the pooled regression results, board size maintains a positive association with the volatility of the operating ratio (sdOpR), although this does not lead to confirmation of our hypothesis, while the effect on (sdROA) becomes negative and statistically significant when alternative specification. In contrast, the previously observed positive and significant influence of gender diversity on corporate risk does not persist when alternative specifications are applied. This attenuation reinforces the heterogeneous and often inconclusive results found in the existing literature on gender diversity in corporate governance. Neither the observed negative relationship of company age with corporate risk does not hold consistently across the models with effects, suggesting that firm maturity alone does not predict the risk behaviour reliably. These findings emphasize the multifaceted nature of boardroom dynamics and support the argument that no uniform pattern of governance attributes can universally explain corporate risk outcomes.

Table 6 - Results of regression models with fixed (FE) and random (RE) effects

Dependent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Independent Variables	sdsDE	sdsDE	sdROA	sdROA	sdOpR	sdOpR
Bsz_w	-0.0088 (-1.1548)	-0.0092 (-1.2010)	-0.0023** (-2.4460)	-0.0023** (-2.3908)	0.0110* (1.8724)	0.0114* (1.9193)
Bgd_w	-0.0001 (-0.0861)	0.0019 (0.3791)	0.0000 (0.0414)	-0.0001 (-0.2162)	-0.0010 (-1.3053)	-0.0025 (-0.8245)
lnTA_w	-0.0056 (-0.2394)	-0.0056 (-0.2400)	-0.0016 (-0.4407)	-0.0016 (-0.4365)	-0.0169 (-0.7076)	-0.0166 (-0.6950)
cAge_w	-0.0033 (-1.4557)	-0.0033 (-1.4528)	0.0012** (2.0754)	0.0013** (2.0833)	0.0066* (1.7592)	0.0067* (1.7802)
sqBgd_w		-0.0000 (-0.4152)		0.0000 (0.2356)		0.0000 (0.4956)
_cons	0.6601 (1.4759)	0.6384 (1.4155)	0.0727 (0.9740)	0.0734 (0.9822)	0.3126 (0.6529)	0.3204 (0.6684)
F statistic			2.4717***	1.9852***	2.1477***	1.7650***
Wald chi2	6.29	6.45				
R-sq overall	0.0089	0.0088	0.0013	0.0011	0.0054	0.0058
Obs	789.0000	789.0000	792.0000	792.0000	778.0000	778.0000
N Companies	217.0000	217.0000	218.0000	218.0000	215.0000	215.0000
Prob > chi2 (Hausman)	0.2314	0.3141	0.0000	0.0000	0.0000	0.0000
FE/RE	RE	RE	FE	FE	FE	FE

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Source: Author's own estimates

CONCLUSION

This study investigated the relationship between board diversity-measured through gender composition and board size-and corporate risk-taking, proxied by the standard deviation of three key financial indicators: financial leverage ratio, return on assets, and operating ratio. The empirical analysis focused on companies operating in selected European countries that adopted early gender quota regulations, using data from the LSEG Workspace (Refinitiv Eikon) database for the period 2020–2023.

While theoretical models often associate female board representation with lower risk due to presumed higher risk aversion, our results offer a more complex picture, highlighting the importance of context, sector, and board dynamics.

Using a combination of pooled OLS, fixed effects, and random effects models, our findings present mixed evidence regarding the impact of board diversity on risk-taking behaviour.

We find a statistically significant positive association between board gender diversity (Bgd) and the volatility of return on assets (ROA) and operating ratio (OpR), suggesting that in certain corporate environments, increased female board participation may coincide with greater firm risk-taking. Nevertheless, gender is not influencing financial leverage. Considering also the expectation model (McGrath at al., 1995) and intergroup contact theory (Pettigrew & Tropp, 2006), our findings suggest that female directors may gradually adopt the dominant decision-making norms of male counterparts, potentially neutralizing presumed differences in risk preferences. This is particularly relevant in boards where group dynamics and prolonged interaction can erode initial behavioural contrasts. These findings align with prior studies (Saeed at al., 2016) suggesting that women may adopt bolder strategies when operating in high-stakes or male-dominated sectors. The robustness checks through fixed and random effects models confirmed the inconsistency of some relationships, particularly the influence of gender diversity, aligning with the heterogeneous findings in existing literature.

Board size exhibited a consistent positive influence on risk-taking, particularly in relation to operating efficiency, though its effect did not consistently reach statistical significance in all model specifications.

These results indicate that board diversity alone does not uniformly influence corporate risk and that contextual factors-such as firm size, industry dynamics, and regulatory environment-likely play a mediating role. The influence of firm-specific characteristics such as company age and size also varied across models, further underscoring the complexity of governance mechanisms in shaping financial outcomes.

In line with the work of (Bhat at al., 2019), our study supports the proposition that relation-oriented diversity attributes (such as gender and board size) may be less effective in explaining firm risk outcomes when compared to task-related attributes like education or tenure. Future research should, therefore, broaden the analysis of board diversity by incorporating additional attributes that can capture the cognitive and experiential composition of corporate boards more accurately.

Practically, these findings urge corporate leaders and policymakers to look beyond gender quotas or board expansion as standalone tools for risk governance. Instead, a multidimensional approach is needed-one that incorporates both relational and task-related diversity - to fully capture the board's capacity to manage strategic risks.

Ultimately, effective corporate governance requires moving beyond symbolic representation to structural understanding where board diversity is not only visible but meaningfully aligned with the firm's strategic objectives and risk profile.

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