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Impact of Management on Financial Performance in the Pharmaceutical Industry

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ABSTRACT

This study examines the impact of board independence, inclusion, research and development (R&D) intensity, and gender diversity on corporate financial performance in the pharmaceutical industry—a critical indicator in financial management. These variables are increasingly relevant to corporate sustainability, especially in the face of a dynamic and highly competitive market environment. Using Partial Least Squares Structural Equation Modeling (PLS-SEM), on a robust dataset of 296 observations from 80 pharmaceutical companies from around the world over a different year period (2011–2022), the research examines how governance and organizational factors influence financial outcomes, measured by Return on Assets (ROA), Return on Equity (ROE), Return on Sales (ROS), and Tobin's Q. Findings reveal that board independence positively affects financial performance. Additionally, innovation—reflected in higher R&D investment—significantly enhances firm performance, underlining its strategic role in competitiveness and growth. Gender diversity and inclusion are also assessed for their contributions to organizational value. The study offers insights for companies and decision-makers, highlighting the importance of integrating governance mechanisms into strategic planning to align with corporate goals and improve financial results.

1 | Introduction

An assessment of financial performance is essential for any type of organisation. The transparency and consistency of financial reporting are monitored through control mechanisms such as the audit committee, which helps ensure oversight of tax practices (Alqatan et al. 2024).

The relationship between corporate sustainable practices (CSR) and financial performance has received growing attention in recent research, as increasingly competitive markets and the accelerating pace of change place unprecedented pressure on companies to not only achieve success, but to sustain it over time (Alshehhi et al. 2018). Considering both corporate value and government strategies directed at organizations, a range of variables has been identified as relevant. In today's rapidly evolving global context, an increasing number of factors can influence a firm's financial performance. In that sense, this study offers a deeper analysis of key elements in the current landscape, namely board independence, inclusion, research and development (R&D) intensity, and gender diversity, with the aim to examine their impact on financial performance in the pharmaceutical companies.

The 2008–2009 financial crisis reignited interest in how companies manage liquidity, as their ability to secure external financing played a crucial role in their survival during that time (Almeida et al. 2014). It is increasingly recognised in the financial profession that the characteristics of a company's ownership structure and financial rights can have a significant impact on its performance (Jensen and Warner 1988). A key capital structure theory suggests that firms adjust over time to stay close to a target balance between tax benefits and bankruptcy costs (Almeida et al. 2011). Financial performance allows analysing

the company's ability to manage and control its own resources during a given period (Fatihudin 2018). In the changing and interconnected environment, different variables have been studied taking into account the performance of an organisation; however, innovation and its impact on performance, from a strategic point of view, have been key in organisations and have attracted the interest of various disciplines for decades (Gök and Peker 2017).

The pharmaceutical industry has a significant impact on the global economy. Its contribution has the capacity to drive employment generation, foster innovation, and stimulate value chains. Elements related to the sustainability process. Therefore, the study of management issues in this industry is relevant for both its stakeholders and the research community (Shah 2004). In particular, pharmaceutical organisations are dedicated to the research, development, and production of medicines, ensuring clearly defined processes and operations (Milanesi et al. 2020). This type of organisation has attracted the interest of many researchers and academics, with some of the main research topics linked to this type of industry being the behaviours they exhibit in a competitive, technological, and regulated environment, and the corporate growth strategies developed such as mergers and acquisitions (Narayana et al. 2012). Innovation in this sector has been key to achieving some of the greatest advances in modern medicine (Lakdawalla 2018). Despite the fact that these organisations have a high number of patents, companies can be active in innovation, even if they do not (Dang 2024).

Given the different established accounting practices, many of them have not been able to adapt to the pace of change in a dynamic environment (Cañibano et al. 2000). Thus, it is essential to analyze variables that have the capacity to affect the world as a whole in order to consider their impact on key elements of an organisation's finances. Thus, the ratios return on assets (ROA), return on equity (ROE), return on sales (ROS), and Tobin's Q and the influence of elements such as board independence, inclusion, research and development (R&D) intensity, and gender diversity on them are key to evaluating the performance and financial impact of these variables considered at an international level in a changing environment.

This research is structured as follows: first, the theoretical framework with the fundamental concepts is presented, which allows the analysis and relevance of the variables selected for the study to be considered. Subsequently, the analysis is presented through the development of the sample and the approach of the statistical model. After this, the results obtained are developed, the discussion of these results is presented, and conclusions are drawn. Finally, the implications of the research, limitations found, and future research lines are pointed out.

2 | Theoretical Background

Pharmaceutical industry operates in a complex ecosystem of stakeholders (Sharma and Agarwal 2024). In the pharmaceutical industry, strategy and knowledge structure, organisational culture, information technology, employee involvement and training, and leadership have been identified as key factors (Hung et al. 2005). Large pharmaceutical companies possess the resources necessary to take advantage of scientific and technological advances; however, they must leverage their scale to recoup huge investments (Peakman et al. 2003). This industry requires a large capital investment to discover drugs through R&D (Hassanzadeh et al. 2014).

Corporate sustainability reporting is underscored as a key measure of the integration of environmental and social management within business processes, examining its effect on financial performance considering variables such as leadership diversity and innovative capacity (Ameer and Othman 2012). Corporate sustainability has been widely recognized as linked to financial performance (Srouji et al. 2023). However, due to the broad range of variables associated with sustainability, this research adopts an approach focused specifically on the social and governmental dimension. In this regard, variables such as board independence, inclusion, R&D intensity, and gender diversity have been selected as crucial for the development of this research, as they represent key aspects of corporate governance and social responsibility that should influence organizational performance.

2.1 | Board Independence

Corporate governance and its impact on corporate profitability or performance are the most debated topics in the current literature (Hasan et al. 2019). Some authors pointed out that CSR-oriented boards positively impact social performance and that their positive effects on financial performance are mediated through CSR governance strategies (Zubeltzu-Jaka et al. 2024). In this regard, it is necessary to highlight that workforce diversity is a multifaceted and constantly evolving concept, considered essential and inevitable for the sustainable performance of organisations, especially in global industries such as pharmaceuticals (Elsaid 2012). Research has been carried out looking at different employees in a pharmaceutical organisation, where elements such as salary, work efficiency, or additional supervision have been identified as major contributors to job satisfaction (Kabir and Parvin 2011).

The board structure constitutes the main governance mechanism within the internal control system of any company or organisation (Hasan et al. 2019). Thus, board size is an important variable for effective board functioning (Rahman et al. 2019). However, it is important to consider the type of organisation; thus, scholars such as Croci et al. (2011) have highlighted that different elements of control can influence the financing decisions of family firms.

The role of boards of directors may differ according to the responsibilities that are carried out, as authors such as Franks et al. (2001) analyse the different disciplinary or advisory functions that are carried out and the particularities of each territory. The ability, willingness, and environment of the board can influence the independent attitude of each director (Fuzi et al. 2016). However, there are different studies that make considerations linking board independence with performance; thus, authors such as Leung et al. (2014) highlight among their results that there is a positively significant relationship between the independence of corporate boards and

board committees and business performance in non-family firms, but this relationship is moderated by the concentration of family ownership. Other scholars, such as Garg (2007) highlight that different proportions of board independence have a different impact on firm performance; however, this does not guarantee that they improve business performance. Thus, taking into account the different results, the characteristics of the company, territory, and other variables should be considered as key elements in the analysis of this relationship. This idea is also highlighted by Fuzi et al. (2016) indicating that the representation of independent directors on the board should show a positive relationship with firm performance. This topic has been extensively studied from different perspectives; Ashwin et al. (2016) discuss how boards directly influence key strategic decisions (such as investing in innovation), thus broadening the focus from considering only their influence on overall outcomes such as earnings.

Board independence is widely recognized as a pillar of good corporate governance, as it enhances the board's ability to monitor management and make objective decisions (Hillman and Dalziel 2003). Empirical evidence from the pharmaceutical sector suggests that a higher proportion of independent and non-executive directors is positively associated with improved financial performance, as these directors provide better oversight and reduce agency problems (Carter et al. 2003; Liu et al. 2015). Specifically, independent board members are seen as more likely to advocate strategic initiatives such as increased R&D investment and ethical decision-making, both of which are critical to the long-term success of pharmaceutical firms (Dalton et al. 1998).

Consequently, with the aim of analyzing its influence on pharmaceutical companies, the following hypothesis has been developed:

Hypothesis 1. *Board independence positively impacts financial performance.*

2.2 | Inclusion

The pharmaceutical industry faces challenges and opportunities in fostering a diverse and inclusive workforce that reflects the needs and experiences of patients and global communities (Sharma and Agarwal 2024). Scholars such as Bhakta et al. (2025) highlight that promoting equity, diversity, and inclusion in the pharmacy profession is critical to ensuring equitable healthcare. Therefore, key variables that play an essential role in the processes within the pharmaceutical sector are re-emphasised.

The concept of inclusion, particularly in the context of employing individuals with disabilities, has been increasingly associated with corporate social responsibility (CSR) and long-term financial performance. Prior studies suggest that inclusive employment practices enhance organizational reputation, employee morale, and stakeholder trust, all of which can positively influence financial outcomes (Hernandez et al. 2000; Lengnick-Hall et al. 2008). In the pharmaceutical sector, where innovation and ethical governance are paramount, fostering inclusion may provide competitive advantages by attracting diverse talent and aligning global sustainability goals (McWilliams and Siegel 2000). Moreover, organizations that actively engage in inclusive practices often experience lower turnover rates and improved employee productivity, further contributing to financial stability and growth (Schur et al. 2009). Thus, it is necessary to test the following hypothesis:

Hypothesis 2. *Inclusion positively impacts financial performance.*

2.3 | R&D Intensity

Economists consider investment in innovation to be a crucial sign of a firm's success (Sanad and Al-Sartawi 2023). They also highlight the crucial role of R&D in stimulating output and productivity (Sharma 2012). R&D investment is crucial in today's economy as it fosters innovation and the creation of new marketable products or services (Chen et al. 2016). R&D funding is expected to accelerate technological breakthroughs and innovation in firms, provide competitive advantage, improve performance, and promote business growth (Sanad and Al-Sartawi 2023).

In this pharmaceutical industry, companies must innovate continuously, developing new products and drug delivery systems based on scientific advancements, to ensure survival and growth globally (Tyagi et al. 2018). Prior studies have shown that higher investments in R&D correlate positively with financial performance, as they enhance the firm's ability to develop new products, enter new markets, and maintain technological leadership (Grabowski and Vernon 2000; Hall and Oriani 2006). The number of products in clinical phases serves as a proxy for innovation productivity, linking the firm's research efforts directly to its pipeline's potential revenue generation (DiMasi et al. 2016). Simultaneously, the logarithm of R&D expenditures captures the scale of investment, reflecting the firm's commitment to innovation as a strategic priority. This industry spends significantly more on R&D relative to its sales revenue compared to almost all other industries (Tyagi et al. 2018).

This is a widely considered topic, as scholars such as Simanjuntak and Tjandrawinata (2011) have determined that R&D spending strategy is influenced by past profitability, R&D intensity, and cash flow, in addition to other factors such as firm performance, firm size, relevant policies, or innovation performance, among others, being several variables able to influence R&D. However, the objective of this research is to analyse the influence of R&D on firm performance. Thus, in this analysis, it is key to prove the following hypothesis.

Hypothesis 3. *R&D intensity positively impacts financial performance.*

2.4 | Gender Diversity

Diversity in the workforce has been a topic that has received significant attention, particularly with studies focused on analyzing the promotion of women and the so-called glass

ceiling (Farrell and Hersch 2005). Adams-Harmon and Greer-Williams (2021) highlight some of the difficulties women face in accessing executive positions in pharmaceutical organisations and point out the need for strategies that favor development towards higher levels. Thus, there has been an ongoing global debate on women's representation in business in recent years (Pletzer et al. 2015). Gender diversity has been widely discussed in the context of corporate governance and organizational performance.

This variable generates differences in results within scientific literature. In particular, the existing research—especially regarding gender diversity—reveals numerous mixed findings that depend on the context of the investigation. For instance, studies on gender diversity have not yielded conclusive results and often present mixed evidence concerning its impact on performance. In that sense, recent literature has supported the idea that the presence of women on boards of directors could improve business innovation due to differences in traits between men and women, influencing the human capital of a company (Terjesen and Singh 2008). Thus, with the aim of increasing the proportion of women on corporate boards, several countries around the world enacted both voluntary and statutory initiatives (Sanad and Al-Sartawi 2023). Ahern and Dittmar (2012) analyzed the impact of gender quota regulations on organizations, which led to changes in board composition, incorporating younger women with less experience, and was associated with weaker financial performance, although the effect cannot be definitively attributed to gender, age, or experience. Other authors such as Adams and Ferreira (2009) pointed out that female directors significantly influence board structure and add value, but there is no evidence that gender quota policies improve overall firm performance.

Academic research suggests that gender-diverse boards and executive teams can lead to improved financial performance by fostering diverse perspectives, enhancing decision-making, and promoting a culture of inclusivity and innovation (Post and Byron 2015; Terjesen et al. 2009). However, the representation of women on corporate boards is not related to the financial performance of companies if other factors are not considered (Pletzer et al. 2015). In that sense, female representation in top executive roles was found to be negatively associated with firm performance, as measured by return on assets (ROA) and Tobin's Q (Darmadi 2013). In the pharmaceutical industry, where creativity and ethical governance are critical, gender diversity may contribute to a more balanced and effective leadership approach, directly influencing key financial outcomes such as ROA and return on equity (ROE) (Isidro and Sobral 2015). Thus, gender diversity is a key variable, and it is essential to continue testing the next hypothesis:

Hypothesis 4. *Gender diversity positively impacts financial performance.*

In view of the aforementioned variables and their link to the financial performance of the organisation, a detailed analysis is proposed to analyse the effect of Board Independence, inclusion, R&D intensity and gender diversity on the performance of pharmaceutical companies. This analysis seeks to understand how the interaction of these variables affects the performance of pharmaceutical companies, providing a comprehensive view that allows us to identify the most effective practices to enhance growth and sustainability in this sector.

3 | Methodology

This section presents the aims of the study, which focuses on evaluating the effects of board independence, inclusion, R&D intensity, and gender diversity on a key variable in corporate financial management—financial performance—in the context of the global pharmaceutical sector. Furthermore, the study examines the influence of two control variables, leverage and size, on financial performance. To fulfill these objectives, Partial Least Squares Structural Equation Modeling (PLS-SEM) is employed, utilizing mode A composites as a robust method for analyzing intricate causal relationships in exploratory research.

3.1 | Research Design

This study utilized Partial Least Squares Structural Equation Modeling (PLS-SEM) to test the relationships between exogenous and endogenous variables within a theoretical model developed for the pharmaceutical industry (see Figure 1). PLS-SEM was selected due to its capacity to handle complex models with reflective composites (Henseler 2017) and its robustness against deviations of normality (Cassel et al. 1999). The measurement model was executed in mode A, which is preferable given the high correlations among predictors, using SmartPLS v 4.0.9.6 software (Ringle et al. 2022).

PLS-SEM served as a versatile statistical method appropriate for this research's exploratory and prediction-oriented nature. The prediction-oriented approach made it an ideal tool for investigating the relationships between constructs in scenarios where theoretical knowledge was still developing (Sarstedt et al. 2017). Additionally, the study employed control variables such as leverage and size, necessitating a statistical method capable of disentangling their effects from the primary relationships under investigation. PLS-SEM allowed for the simultaneous inclusion of control variables, enhancing the robustness of the hypothesized relationships (Rigdon 2012).

3.2 | Theoretical Model and Variables

The theoretical model, depicted in Figure 1, included four exogenous variables: Board independence, inclusion, R&D intensity, and gender diversity. The single endogenous variable was financial performance, while two control variables, leverage and size, were also incorporated into the model to account for their potential influence.

3.2.1 | Variables and Indicators

Table 1 provides the details of the latent variables, their associated indicators, and definitions. The exogenous constructs of the model were board independence, inclusion, R&D intensity,

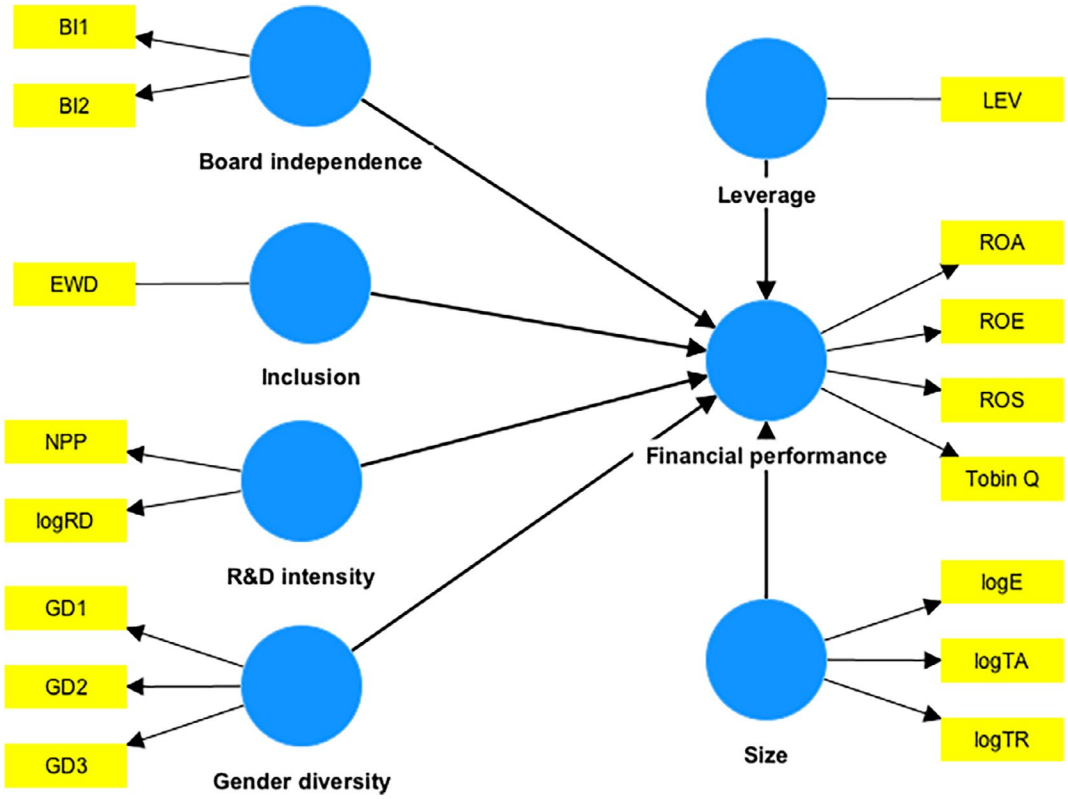

FIGURE 1 | The theoretical model of the composite nomogram.

and gender diversity. Endogenous constructs included financial performance, measured by indicators such as ROA, ROE, ROS, and Tobin Q.

Control variables included size, measured by logarithms of employees, total assets, and total revenue, and leverage, represented by the ratio of total debt to equity.

The latent variable **board independence** was included in the model as an explanatory construct to evaluate its influence on the financial performance of pharmaceutical firms. It was operationalized through two key indicators sourced from the Eikon database: (i) Non-executive board members, which measures the proportion of board members who do not hold executive roles within the firm, and (ii) independent board members, which captures the percentage of directors who are free from any material relationship with the company beyond their board role.

The latent variable **inclusion** was represented by the indicator employees with disabilities, which measures the proportion of employees within the organization identified as having disabilities. This data was sourced from the Eikon database, ensuring a standardized and reliable metric for assessing inclusion efforts (Noja et al. 2021) seeking to explore the nuanced relationship between workforce diversity, in the form of employing individuals with disabilities, and the financial performance of firms. Consistent with our construct definition, we modeled inclusion (disability) as a single-indicator reflective construct using Refinitiv/Eikon's TR. EmployeesWithDisabilities metric. We avoided combining heterogeneous inclusion items (e.g., flexible work hours, day-care, HIV/AIDS programs) to preserve content validity around disability inclusion and because comparable disability-specific indicators are not consistently available across firms/years.

By including **R&D intensity** as a latent construct, this study aims to elucidate the mechanisms through which innovation-oriented investments translate into improved financial performance. It was measured using two key indicators: (i) number of products in clinical phases and/or in pre-registration (NPP), which reflects the firm's innovation pipeline, and (ii) logarithm of R&D expenditures, capturing the level of financial resources allocated to research and development activities. R&D intensity is a critical determinant of financial performance, particularly in the pharmaceutical sector, where innovation drives competitive advantage and long-term growth.

By examining **gender diversity** as a latent construct, this study aims to deepen our understanding of diversity's role in driving corporate success in the pharmaceutical industry. It was measured using three indicators sourced from the Eikon database: (i) board gender diversity, percent, which represents the proportion of women on the firm's board of directors; (ii) women employees, capturing the overall percentage of female employees within the organization; and (iii) executive members gender diversity, percent score, which reflects the representation of women in executive leadership roles.

The latent variable **financial performance** was employed as the primary dependent construct in this study, capturing the overall financial outcomes of pharmaceutical firms. It was measured using four key indicators: (i) return on assets (ROA), which evaluates a firm's ability to generate profits relative to its total assets; (ii) return on equity (ROE), reflecting the efficiency with

TABLE 1 | Latent variables, indicators and definitions.

Latent variables	Indicators	Definitions
Board independence	BI1	Non-executive board members %
	BI2	Independent board members %
Inclusion	EWD	Employees with disabilities %
R&D intensity	NPP	Number of products in clinic phases and/or in pre-registration
	logRD	Logarithm R&D expenditures
Gender diversity	GD1	Board gender diversity, percent
	GD2	Women employees %
	GD3	Executive members gender diversity, percent score
Financial performance	ROA	Return on assets
	ROE	Return on equity
	ROS	Return on sales
	TobinQ	Tobin Q. Market value for company/Total assets
Size	logE	Logarithm of number of employees
	logTA	Logarithm total assets
	logTR	Logarithm total revenue
Leverage	Lev	Leverage

Source: Eikon from Thomson Reuters (2024).

which a firm utilizes shareholder equity to produce net income; (iii) return on sales (ROS), measuring profitability relative to revenue; and (iv) Tobin Q, which represents the ratio of a firm's market value to the replacement cost of its assets, providing a market-based assessment of its performance. These indicators are widely recognized in academic literature for their relevance and robustness in assessing financial performance, particularly in the pharmaceutical sector. ROA and ROE are commonly used to gauge operational and financial efficiency, offering insights into how effectively resources are being managed to deliver profitability (Hitt et al. 1996; King and Lenox 2002). ROS highlights the firm's capacity to translate revenues into profit margins, which is critical in an industry characterized by high R&D expenditures and regulatory constraints (Pisano 1997). Tobin Q, as a forward-looking measure, reflects market expectations of a firm's growth potential and its ability to sustain competitive advantage through innovation (Grabowski and Vernon 2000; Hall 1993).

By integrating these indicators, the construct financial performance provides a comprehensive view of the economic and strategic outcomes of pharmaceutical firms, enabling an in-depth analysis of the impact of governance practices, inclusion efforts, and innovation intensity on their financial success. This thorough analysis provides valuable insights for managers, regulators, and policymakers, emphasizing the intricate link between governance strategies and financial stability in the dynamic and innovation-driven pharmaceutical industry.

3.3 | Data Collection and Sample

The data were obtained from secondary sources, the Eikon database from Thomson Reuters, covering a representative sample of pharmaceutical companies over the period 2011–2022, 296 observations in the form of unbalanced panel data. The sample comprised 80 pharmaceutical companies from around the world, ensuring a representative analysis across the industry. The initial population consisted of 109 firms that disclosed data for the variable employees with disabilities at least once during the period 2011–2022. This variable, central to our analysis, is not consistently reported by all firms or in every year. After applying the PLS-SEM data quality rule that missing data per indicator must not exceed 5% (Hair et al. 2019), we retained 80 firms with a total of 296 firm-year observations. The discrepancy between the theoretical maximum (up to 960 observations) and the final number reflects variation in ESG data availability, particularly for earlier years and in less regulated jurisdictions. The final sample balances the representativeness of the pharmaceutical sector with the methodological requirements of the model.

The adequacy of the sample size was determined based on PLS-SEM guidelines, which recommend a minimum sample size that ensures reliable model estimation, particularly when examining complex models with multiple paths and constructs (Cohen 1992). When the maximum number of independent variables in the measurement and structural models is three, approximately 37 observations would be needed to achieve a statistical power of 80% to detect R^2 values of at least 0.25, with a 5% probability of error.

3.4 | Evaluation of the Measurement Model

The measurement model was assessed for reliability and validity using multiple criteria. Indicator reliability was evaluated by examining outer loadings, with a threshold of 0.707 as the minimum acceptable value (Hair et al. 2019). Indicators with loadings below this threshold were considered for removal if their retention compromised content validity (Chin 1998). It should be noted that some indicators, such as independent board members or products in clinical phases, were removed as they did not meet the minimum loading thresholds required in reflective mode A models. This refinement followed methodological criteria (Hair et al. 2019) to ensure the reliability and validity of the measurement model, without implying that these indicators lack relevance in other contexts or time periods.

Internal consistency reliability was confirmed using Cronbach's alpha and composite reliability metrics, both of which exceeded the 0.7 benchmark for all constructs (Henseler et al. 2009; Nunnally and Bernstein 1994).

Convergent validity was assessed through the Average Variance Extracted (AVE), with all constructs achieving AVE values above the 0.5 threshold (Fornell and Larcker 1981). Discriminant validity was verified using both the Heterotrait-Monotrait (HTMT) ratio and the Fornell-Larcker criterion, with results confirming that all constructs were distinct (Fornell and Larcker 1981; Henseler et al. 2015).

3.5 | Evaluation of the Structural Model

The structural model was evaluated following the validation of the measurement model. Multicollinearity was assessed using the Variance Inflation Factor (VIF), with all VIF values below the recommended threshold of 3.3, indicating no significant collinearity issues (Hair et al. 2017). Bootstrapping with 10,000 resamples was employed to test the significance of path coefficients, *t*- and *p*-values for each hypothesized relationship (Chin 1998).

The structural model's explanatory power was evaluated using the R^2 values for the endogenous construct, financial performance, and the effect sizes (f^2) for the relationships between constructs were calculated to assess the magnitude of their impacts (Cohen 1988).

To explicitly address the risk of endogeneity, omitted variable bias, and reverse causality, we conducted a robustness test using the Gaussian copula approach (Park and Gupta 2012; Hult et al. 2018). This method has been increasingly applied in PLS-SEM research in management and finance, as it allows testing and correcting for endogeneity without relying on external instrumental variables, which are often unavailable or weak in corporate governance studies. For each potentially endogenous regressor, a Gaussian copula term was generated and incorporated into the structural model. If the copula term is significant, the presence of endogeneity is indicated; if not, the relationship can be considered robust. This procedure reinforces the validity of our findings and enhances confidence in the causal interpretation of the model.

In addition, we specify the structural model equation:

$$\mathrm{FP} = \beta_1 BI + \beta_2 \mathrm{INCL} + \beta_3 \mathrm{R\&D} + \beta_4 \mathrm{GD} + \beta_5 \mathrm{SIZE} + \beta_6 \mathrm{LEV} + \varepsilon$$

where FP denotes financial performance (ROA, ROE, ROS, Tobin's Q); BI is board independence; INCL is inclusion (employees with disabilities); R&D is R&D intensity; GD is gender diversity; SIZE is firm size; and LEV is leverage.

3.6 | Analytical Tools

The data analysis was performed using SmartPLS 4.0.9.6, a software specifically designed for PLS-SEM analysis (Ringle et al. 2022). This tool provided robust capabilities for estimating complex models with both reflective and formative composites, ensuring reliable and accurate results.

The research process followed a structured sequence: (1) definition of constructs and hypotheses; (2) data extraction from Refinitiv/Eikon; (3) cleaning and pre-processing of ESG and financial indicators, excluding those with more than 5% missing data; (4) construction of latent variables and operationalization of indicators; (5) estimation of the measurement model and refinement of indicators with low loadings; (6) evaluation of the structural model using PLS-SEM (bootstrapping, R^2, f^2, Q^2); and (7) robustness checks using Gaussian copulas.

4 | Results

The results presented in this section evaluate the hypotheses developed in the study. Using Partial Least Squares Structural Equation Modeling (PLS-SEM), the relationships among the exogenous variables (board independence, inclusion, R&D intensity, and gender diversity), the endogenous variable (financial performance), and control variables (leverage and size) were tested. This analysis provides insights into the drivers of financial performance in the pharmaceutical sector.

4.1 | Evaluation of the Measurement Model

The measurement model was first validated to ensure the reliability and validity of the constructs. Indicator reliability was assessed by examining the outer loadings, with values above the threshold of 0.707 retained for further analysis. Indicators with lower loadings, such as BI2 for board independence, G1 and G2 for gender diversity, or NPP for R&D intensity, were excluded due to their limited contribution to the respective constructs (see Table 2).

To increase transparency, we added a descriptive statistics table reporting means, standard deviations, and missing data percentages for all variables used in the analysis (see Table A1 in Appendix A). This allows readers to assess the sample characteristics more clearly.

It should also be noted that some indicators in Table 2 (e.g., BI1 = −1.00, GD3 = 0.40) displayed low or even negative outer loadings during reliability assessment. These values are not coding errors but reflect the estimation properties of the PLS algorithm when indicators contribute little or inconsistently to their latent construct. In line with established methodological guidelines (Hair et al. 2019), these indicators were removed from the measurement model to ensure reliability and validity.

Internal consistency reliability was confirmed using Cronbach's alpha and composite reliability metrics (Dijkstra–Henseler's index and Jöreskog's composite reliability), with all constructs exceeding the minimum benchmark of 0.7. Convergent validity was verified by ensuring that the average variance extracted (AVE) values for all constructs surpassed 0.5 (Table 3).

Discriminant validity was established through the Heterotrait-Monotrait (HTMT) ratio and the Fornell-Larcker criterion, confirming that the constructs were sufficiently distinct (Tables 4 and 5).

For the HTMT ratio, all construct pairs achieved values below the conservative threshold of 0.85, indicating strong

TABLE 2 | Load of indicators.

Board independence	Load	R&D intensity	Load	Gender diversity	Load
BI1	−1.00	NPP[a]	−0.23	GD1[a]	0.10
BI2[a]	−0.49	logRD	0.86	GD2	0.99
				GD3[a]	0.40
Financial performance	**Load**	**Size**	**Load**		
ROA	0.84	logE	0.91		
ROE[a]	0.40	logTA	0.97		
ROS	0.81	logTR	0.97		
Tobin Q	0.81				

[a]Indicators removed.

TABLE 3 | Reliability and construct validity.

	Cronbach's Alpha	Dijkstra–Henseler's index	Jöreskog's composite reliability	Average variance extracted (AVE)
Financial performance	0.78	0.78	0.87	0.69
Size	0.95	0.96	0.97	0.90

TABLE 4 | Discriminant validity HTMT ratio.

	Board independence	Financial performance	Gender diversity	Inclusion	Leverage	R&D intensity
Financial performance	0.13					
Gender diversity	0.36	0.37				
Inclusion	0.15	0.13	0.39			
Leverage	0.24	0.29	0.3	0.01		
R&D intensity	0.12	0.19	0.24	0.32	0.14	
Size	0.24	0.32	0.17	0.15	0.15	0.74

TABLE 5 | Fornell-Larcker criterion.

	Board independence	Financial performance	Gender diversity	Inclusion	Leverage	R&D intensity	Size
Board independence	**1**						
Financial performance	−0.12	**0.83**					
Gender diversity	0.36	−0.34	**1**				
Inclusion	0.15	−0.13	0.39	**1**			
Leverage	0.24	−0.25	0.3	0.01	**1**		
R&D intensity	0.12	−0.18	0.24	0.32	0.14	**1**	
Size	0.23	−0.3	0.18	0.14	0.15	0.73	**0.95**

discriminant validity. This ensures that the constructs are conceptually distinct and not excessively correlated. Additionally, the Fornell-Larcker criterion was applied, requiring that each construct's square root of the average variance extracted (AVE) be greater than its highest correlation with any other construct (Table 5).

This condition was satisfied for all constructs in the model, further confirming their distinctiveness. The results from both methods, as summarized in Tables 4 and 5, demonstrate that the constructs met the necessary thresholds for discriminant validity, supporting the robustness of the measurement model.

4.2 | Evaluation of the Structural Model

Following the validation of the measurement model, the structural model was evaluated to test the hypotheses and assess the relationships between constructs. Multicollinearity was examined using the variance inflation factor (VIF), with all values below the recommended threshold of 3.3, indicating no significant multicollinearity issues.

The structural model was analyzed using bootstrapping with 10,000 resamples, which calculated path coefficients, *t*-, *p*-values, and confidence intervals. Bootstrapping with 10,000 subsamples revealed the significance of path coefficients for each hypothesized relationship (Table 6 and Figure 2).

4.2.1 | Hypothesis Testing

The relationship between board independence and financial performance was positive and significant ($\beta = 0.10$, $t = 1.84$, $p < 0.05$), supporting Hypothesis 1. This result highlighted the importance of independent governance in improving financial outcomes in pharmaceutical firms. The impact of inclusion (employees with disabilities) on financial performance was not statistically significant ($\beta = -0.05$, $t = 1.02$, $p > 0.05$). This suggests that the inclusion of employees with disabilities does not directly influence financial performance within the sample analyzed, so inclusion practices may require further contextual analysis to determine their financial implications. R&D intensity exhibited a strong positive effect on financial performance ($\beta = 0.20$, $t = 2.26$, $p < 0.05$), confirming that higher investment in innovation and product development leads to improved financial metrics. This reinforces the critical role of innovation in encouraging competitive advantage and financial success. Gender diversity negatively impacted financial performance ($\beta = -0.29$, $t = 4.13$, $p < 0.05$), contrary to expectations. This unexpected result may reflect industry-specific dynamics or cultural influences within the sector.

The control variables also demonstrated significant relationships with financial performance. Leverage showed a negative effect ($\beta = -0.16$, $t = 2.00$, $p < 0.05$), indicating that firms with lower debt levels achieve better financial outcomes. Similarly, size negatively influenced financial performance ($\beta = -0.39$, $t = 3.78$, $p < 0.05$), suggesting that smaller firms are more agile and adaptable in the pharmaceutical industry. These findings emphasize the importance of maintaining efficient financial structures and adaptable organizational sizes to improve performance.

The findings of this study provide valuable insights into the drivers of financial performance in the pharmaceutical industry. The positive effects of board independence and R&D intensity highlight the critical role of governance and innovation in achieving financial success. However, the lack of significance for inclusion and the unexpected negative association of gender diversity with financial performance suggest that these factors may have complex, context-dependent influences. The significant relationships observed for leverage and size emphasize the need for balanced financial strategies and optimized organizational scales in a highly competitive and innovation-driven sector.

BI1(Non-executive board members); EWD(Employees with disabilities); logRD(Logarithm R&D expenditures); GD2(Women employees); LEV(Leverage); ROA(Return on assets); ROS(Return on sales); Tobin Q(Tobin Q); logE(Logarithm of number of employees); logTA(Logarithm Total Assets); logTR(Logarithm TotalRevenue).

TABLE 6 | Results of the structural model.

	Path	*t*	*p*	CI 5.0%	CI 95.0%	Conclusion
Board independence–>Financial performance	0.10	1.84	0.03	0.01	0.18	Hypothesis 1 supported
Inclusion–>Financial performance	−0.05	1.02	0.15	−0.12	0.03	Hypothesis 2 not supported
R&D intensity–>Financial performance	0.20	2.26	0.01	0.06	0.35	Hypothesis 3 supported
Gender diversity–>Financial performance	−0.29	4.13	0.00	−0.40	−0.17	Hypothesis 4 not supported
Control variables						
Leverage–>Financial performance	−0.16	2.00	0.02	−0.31	−0.05	
Size–>Financial performance	−0.39	3.78	0.00	−0.55	−0.22	

Note: t statistics and confidence intervals were performed by a 10,000-resampling percentile bootstrapping procedure.

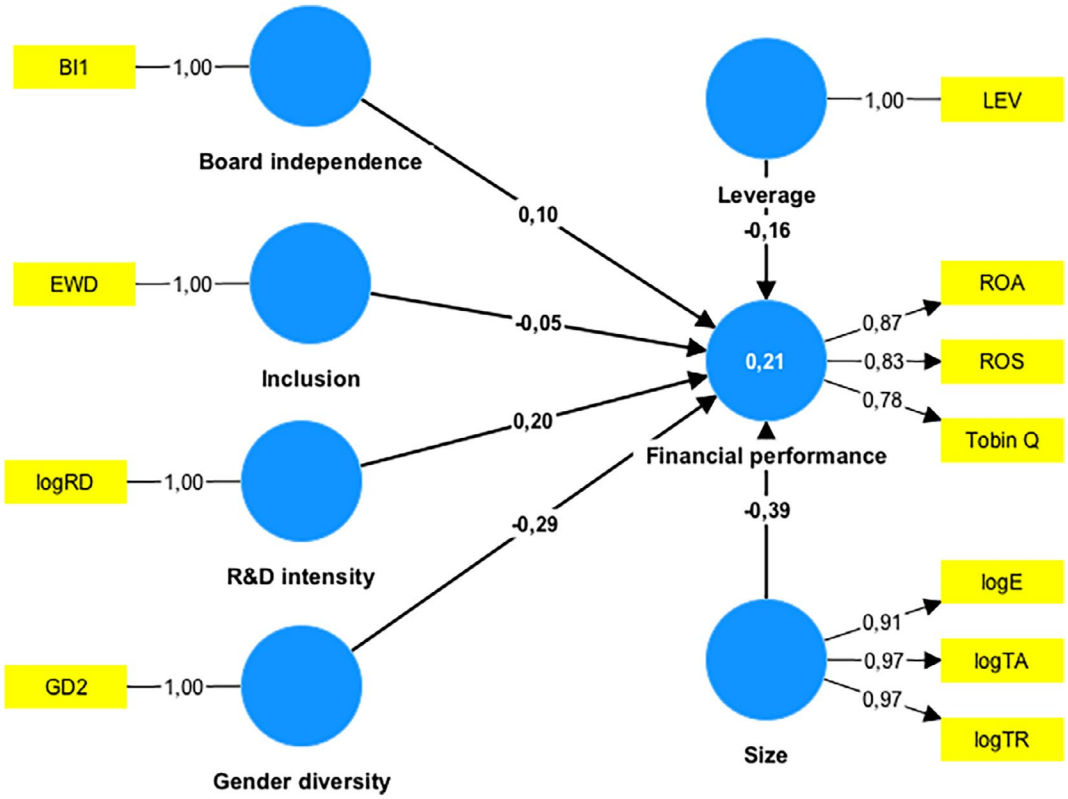

FIGURE 2 | Results of the model.

The R^2 value for the endogenous construct financial performance was 0.21, indicating an adequate level of explained variance (Falk and Miller 1992). Effect sizes (f^2) were calculated to assess the magnitude of each predictor's impact on financial performance. In our case, f^2 values ranging from 0.01 to 0.08 indicated a small effect size, in line with Cohen's (1988) heuristic guidelines.

4.3 | Robustness Check: Gaussian Copula Test for Endogeneity

To further assess the robustness of our findings and explicitly address potential endogeneity concerns, we applied the Gaussian copula approach, following Park and Gupta (2012) and Hult et al. (2018). This method allows us to detect simultaneity and omitted variable bias without relying on external instruments, which are often unavailable in corporate governance research.

Table A2 (Appendix A) presents the results of the endogeneity test. For board independence, inclusion, and R&D intensity, the Gaussian copula terms were not statistically significant ($p > 0.05$), suggesting that the estimated path coefficients for these constructs are robust and not affected by endogeneity. However, the copula term for gender diversity was consistently significant ($p < 0.05$) across specifications, indicating simultaneity issues in this construct.

These results suggest that the negative relationship between gender diversity and financial performance observed in our baseline model may be partly driven by endogenous dynamics, where financial outcomes and board composition mutually influence each other. This reinforces the interpretation that quantitative representation alone may not capture the full effect of gender diversity and highlights the need to consider qualitative and contextual factors (e.g., decision-making influence, cultural norms, or industry-specific dynamics).

5 | Discussion

The findings of this study provide several key insights into the factors influencing financial performance in the global pharmaceutical sector. First, the significant positive association between board independence and financial performance underscores the essential role of governance structures in fostering corporate success. Independent board members are recognized for their ability to mitigate agency conflicts and enhance the quality of strategic decisions by prioritizing oversight and ethical considerations (Baysinger and Butler 1985; Zahra and Pearce 1989). These findings are consistent with existing literature that emphasizes the importance of governance quality, particularly in highly regulated industries like pharmaceuticals, where ethical decision-making and compliance with regulatory frameworks are critical for maintaining stakeholder trust and achieving financial stability (Bhagat and Bolton 2008; Larcker and Tayan 2013).

The influence of inclusion, measured through employees with disabilities, did not demonstrate a statistically significant impact on financial performance. While inclusion is increasingly recognized as a cornerstone of corporate social responsibility (CSR), its financial implications may be more context dependent.

Further research is needed to explore the pathways through which inclusion practices impact financial outcomes, particularly in innovation-driven industries like pharmaceuticals.

The robust positive relationship between R&D intensity and financial performance highlights the fundamental importance of innovation in achieving competitive advantage. Metrics such as the number of products in clinical development and R&D spending serve as indicators of a firm's strategic focus on innovation, which is strongly linked to increased profitability and enhanced market positioning. These results align with existing research emphasizing that substantial R&D investments enable firms to maintain technological leadership, foster product differentiation, and access new market opportunities (Cohen and Levinthal 1990; Hall and Oriani 2006). In the pharmaceutical sector, such innovation-driven strategies are particularly critical due to the industry's reliance on continuous product development and adaptation to regulatory requirements (Pammolli et al. 2011; Scherer 2001).

Although the R^2 value of 0.21 for financial performance indicates moderate explanatory power, this limitation is acknowledged. However, in prediction-oriented research, such as ours, predictive relevance is often more critical than explanatory capacity. To assess this, we applied the blindfolding procedure, obtaining positive Q^2 values for the endogenous construct, which confirms the model's predictive validity (Fornell and Larcker 1981; Hair et al. 2019). Thus, while explanatory power is limited, the predictive orientation of PLS-SEM supports the adequacy of our model (Chin 1998; Rigdon 2012).

The unexpected negative association between gender diversity and financial performance warrants further examination. While gender diversity has been linked to improved decision-making and innovation (Post and Byron 2015; Terjesen et al. 2009), its impact in the pharmaceutical sector does not remain reflected. In this specific case, probably due to particular factors of the context or industry analyzed. It should be noted that gender diversity is measured only in quantitative terms, ignoring qualitative aspects like the actual influence or roles women play in decision-making processes. In this regard, the complexity of the relationship, as highlighted by various authors (Darmadi 2013; Ahern and Dittmar 2012; Adams and Ferreira 2009), underscores the need for further research to disentangle the contextual factors involved.

The negative association observed between gender diversity and financial performance requires careful interpretation. While much of the literature highlights positive or mixed effects of gender diversity (Adams and Ferreira 2009; Ahern and Dittmar 2012; Darmadi 2013), our robustness analysis using Gaussian copulas revealed that this construct is significant under endogeneity correction. This suggests that the relationship may be affected by simultaneity, whereby firms' performance and the appointment of women to boards and executive roles influence each other. Such dynamics indicate that beyond numerical representation, contextual barriers, cultural norms, and the actual influence of women in decision-making positions are critical factors shaping outcomes. This complexity underscores the need for further research that incorporates qualitative dimensions of gender diversity and considers institutional and cultural environments when evaluating its financial implications.

The significant negative effects of the control variables, leverage and size, highlight the importance of maintaining financial and organizational efficiency. Firms with lower debt levels and smaller organizational sizes exhibited better financial performance, suggesting that agility and resource management are critical in a highly regulated and competitive industry.

6 | Conclusions

Based on a sample of 296 observations of 80 pharmaceutical companies from around the world during the period 2011–2022, a study was carried out to analyse whether variables such as board independence, inclusion, R&D intensity, and gender diversity have an impact on performance. In this case, performance has been considered taking into account the ROA, ROE, ROS, and Tobin Q ratios. The results demonstrate the influence of governance and R&D on the positive effects of board independence. It also highlights that gender inclusion and diversity do not directly interfere with performance, which shows that in this case, these variables do not affect organisational performance and could be integrated as normal characteristics of corporate governance. At the same time, it should be noted that the performance of a company may depend on more complex and interrelated factors, which would lead to overshadowing the specific effects of these variables. These results highlight the importance of people management variables on business performance, providing business leaders with a greater understanding of the key factors to consider when designing a comprehensive management strategy for the company.

7 | Managerial and Practical Implications

From a theoretical point of view, this research enriches science by incorporating detailed specifications on the pharmaceutical industry and the management of its boards. By analysing in depth the key aspects of governance in this sector, it generates knowledge that contributes to the development of more robust theoretical models on issues related to management and strategic direction. In addition, the study provides a basis for understanding how board decisions influence organisational effectiveness, particularly in a sector characterised by high levels of regulation and an intensive focus on R&D. Thus, in the social and governance dimensions derived from a global sustainable perspective, key variables are highlighted that can significantly impact financial performance, and business leaders should carefully consider these factors when developing their sustainability strategies.

From a practical perspective, this research provides valuable insights for companies and business leaders to incorporate governance systems into strategic decision-making, ensuring alignment with corporate objectives. It is recommended to prioritize transparency in management processes to achieve this alignment effectively. Furthermore, given that these are highly regulated industries, maintaining trust amid continuous

environmental changes requires the establishment of clear mechanisms for risk management and rapid adaptation to potential regulatory modifications. As these companies are inherently innovation-driven, it is crucial to continue promoting innovation as a key and strategic element for sustaining competitiveness and long-term success.

8 | Limitations and Future Research Lines

The analysis in this research covers the period from 2011 to 2022. However, it could be replicated for other periods, incorporating new key elements. Governance practices vary across companies and regions, which could influence the interpretation of results due to differences in policies and strategies implemented. Furthermore, the study does not consider external factors such as economic crises, pandemics, or global political changes, as it focuses on internal aspects of companies. Therefore, the results should be interpreted taking into account the particularities detailed in the research.

Future researchers are encouraged to continue the analysis by taking into account concrete policies that directly influence the governance of such organisations. It would also be interesting to analyse the effect of policy changes and their influence on boards. In companies, at an internal level, there are different variables linked to personnel management, such as incentives and training programmes that could be included in the performance; thus, through these results, new lines of research are proposed, highlighting the repercussion of these companies on society and their influence on the management of the company.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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Appendix A

TABLE A1 | Descriptive statistics.

Variable	Mean	Std. Dev.	Min	Max	Missing
Tobin Q	2.11	1.73	0	11.81	0
ROA	0.07	0.07	−0.17	0.6	0
ROE	0.13	0.22	−0.71	2.41	0
ROS	0.13	0.12	−0.64	0.51	0
BI1	66.92	20.97	0	100	0
BI2	46.64	20.42	0	100	0
ETI1	1.52	1.47	0	9.1	0
GD1	19.26	13.13	0	57.14	0
GD2	36.8	16.67	0.69	83.5	0
GD3	15.44	13.89	0	66.67	0
NPP	12.35	19.65	0	133	0
logRD	8.07	1.03	5.11	9.94	0
LEV	0.5	0.99	0	7.57	0
logE	3.95	0.58	2.59	5.07	13
logTR	9.39	0.71	7.75	10.76	0
logTA	9.66	0.72	8	11.18	0

Note: Descriptive statistics are based on the final sample of 296 firm–year observations. Missing values did not exceed 5% for any indicator, in line with PLS-SEM data quality guidelines (Hair et al. 2019).

TABLE A2 | Assessment of endogeneity test using the Gaussian copula approach.

Test	Construct	Coefficient	*p*
One copula			
Gaussian copula of model 1 (endogenous variables: BI)	GC (Board independence)–> Financial performance	−0.12	0.25
Gaussian copula of model 2 (endogenous variables: Inclusion)	GC (Inclusion)–> Financial performance	0.08	0.28
Gaussian copula of model 3 (endogenous variables: R&D intensity)	GC (R&D intensity)–> Financial performance	0.09	0.44
Gaussian copula of model 4 (endogenous variables: Gender diversity)	GC (Gender diversity)–> Financial performance	0.99	0.01 s
Two copulas			
Gaussian copula of model 5 (endogenous variables: BI, Inclusion)	GC (Board independence)–> Financial performance	−0.13	0.23
	GC (Inclusion)–> Financial performance	0.1	0.26
Gaussian copula of model 6 (endogenous variables: BI, R&D intensity)	GC (Board independence)–> Financial performance	−0.12	0.25
	GC (R&D intensity)–> Financial performance	0.09	0.44
Gaussian copula of model 7 (endogenous variables: BI, Gender diversity)	GC (Board independence)–> Financial performance	−0.07	0.35
	GC (Gender diversity)–> Financial performance	0.98	0.01 s
Three copulas			
Gaussian copula of model 8 (endogenous variables: BI, Inclusion, R&D intensity)	GC (Board independence)–> Financial performance	−0.13	0.23
	GC (Inclusion)–> Financial performance	0.1	0.26
	GC (R&D intensity)–> Financial performance	0.11	0.43
Gaussian copula of model 9 (endogenous variables: BI, Inclusion, Gender diversity)	GC (Board independence)–> Financial performance	−0.08	0.32
	GC (Inclusion)–> Financial performance	0.1	0.24
	GC (Gender diversity)–> Financial performance	0.98	0.01 s
Gaussian copula of model 10 (endogenous variables: BI, R&D intensity, Gender diversity)	GC (Board independence)–> Financial performance	−0.07	0.35
	GC (R&D intensity)–> Financial performance	0.05	0.46
	GC (Gender diversity)–> Financial performance	0.98	0.01 s
Gaussian copula of model 11 (endogenous variables: Inclusion, R&D intensity, Gender diversity)	GC (Inclusion)–> Financial performance	0.1	0.26
	GC (R&D intensity)–> Financial performance	0.08	0.45
	GC (Gender diversity)–> Financial performance	1	0.01 s
Four copulas			
Gaussian copula of model 12 (endogenous variables: BI, Inclusion, R&D intensity, Gender diversity)	GC (Board independence)–> Financial performance	−0.08	0.32
	GC (Inclusion)–> Financial performance	0.11	0.24
	GC (R&D intensity)–> Financial performance	0.08	0.45
	GC (Gender diversity)–> Financial performance	0.98	0.01 s

Note: s indicates endogeneity problem in the construct.