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Artificial Intelligence's Moderating Role in Board Gender Diversity, Firms Performance and Earnings Management

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Abstract: The involvement of female directors on corporate boards has garnered significant attention in recent years. Nevertheless, the financial implications remain ambiguous, particularly in the developing region. This study investigates the impact of female directors on governance effectiveness, specifically regarding earnings management practices and firm financial performance. The research also emphasizes the significance of artificial intelligence (AI) as assessed by the frequency of AI-related terminology reported by companies. The study sample comprised selected companies listed on the Bahrain Bourse. The results indicated that female directors significantly impact firms' performance, as assessed by the return on asset ratio. Furthermore, female directors effectively oversee firms' financial practices, as a negative and significant correlation was identified between female directors and earnings management. The AI variable significantly and positively impacted the relationship between female directors and corporate performance and earnings management practices, suggesting that technology is crucial in aiding female directors' decision-making on boards. The study's findings are important for policymakers, shareholders, academics, and practitioners interested in board gender diversity and the application of AI in the financial sector.

Keywords: Artificial Intelligence, Bahrain, Corporate governance, Earnings Management, Female Directors.

1 Introduction

The increasing number of corporate scandals in the past few decades has heightened awareness regarding the significance of corporate governance, earnings management mechanisms, and firm performance. The unexpected failures of major corporations, primarily due to poor governance, have adversely impacted global financial markets. Prior research indicated that corporate governance practices could affect earnings manipulation as well as company performance as a whole.

In this context, the diversity of board members has played a significant role in addressing board independence and better monitoring and controlling of the management. Board diversity is considered as one of the corporate governance mechanisms that it widely discussed in the literature, and it can be classified into two main categories: demographic (ethnicity, age, gender, and race) and cognitive (knowledge, skills, values, expertise, perception). Based on the literature, gender diversity is one of the most important aspects to stakeholders [1].

There is growing attention in corporate governance literature concerning board gender diversity and its significant impact on improving business performance. However, a review of the literature shows contradictory results where positive and negative effects can arise. The contradictory in research can be due to several reasons such as differences in timeframe, different institutional (regulatory and legislative) contexts, number of control variables, limited and non-harmonized measures of performance [2,3].

The previous corporate scandals and crisis such as Enron and WorldCom have emphasized on the presence of female directors to help in preventing any future financial scandal [1]. Besides, the focus on earnings management practices has increased, especially after the corporate scandals and many studies called for testing the impact of board characteristics on eliminating the opportunistic earnings management practices [4].

It is evidenced by previous research that gender diversity is a source of competitive advantage, business value, a broader base of knowledge, creativity and

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innovation which can eventually lead to better decision-making processes and performance [5]. However, the number of female directors on the boardrooms worldwide is still low. For instance, statistics show that women consist of only 19.8% of board members of companies in the 2017 Fortune 1000 companies which could be due to several interesting reasons such as gender bias observed in management feedback, remuneration, promotion, performance appreciation, valuation of work, disrespect, sexual harassment, etc. [6].

In addition, artificial intelligence (AI) and information technology (IT) have become an important factor in several core activities and processes in the business world. AI can influence a firm's performance by enhancing its communication channels, networking with key stakeholders, improving operations and business functions, and increasing the overall effectiveness and efficiency (Wamba, et al. 2020). Based on the aforementioned studies, it can be suggested that the presence of female directors would have a significant impact on firm's engagement in AI practices and this is because female directors would bring new perspectives and viewpoints and improve innovation and the exploration of new AI applications. This can enhance the decision-making process and build more comprehensive discussions on the board. Female presentation on the board can also lead to better talent acquisition where a diverse pool of talents is attracted which can bring new and innovative ideas [7].

Moreover, although there are many previous studies that investigated the relationship between female directors and firms' outcomes such as financial performance and earnings management practices [8,9,10], the findings are still inconclusive. For instance, some studies revealed no correlation between female directors and firm value or profitability [8,9], while [11] research indicated a positive and significant correlation between the presence of women on corporate boards and organizational performance. Also, [10] found that the presence of female directors would reduce earnings management practices. On the other hand, [12] findings indicated a negative and significant correlation between the inclusion of women on boards and earnings management. Hence, there is a need to further investigate the firms' outcomes to better understand the consequences of increasingly appointing female directors. Besides, with the rapid increase of AI applications in the corporate world, it is crucial to see whether the AI would affect the association between female directors and firms' performance as well as earnings management.

Therefore, the current study mainly analyzes the consequences of appointing female directors on corporate boards. In particular, the study aims to examine the impact of board gender diversity on a firm's performance measured by return on assets (ROA). The study also investigates if board gender diversity would contribute to better overseeing the firms' management and eliminating

earnings management practices. Furthermore, the study investigates the role of AI disclosure in influencing these two relationships. The study employs a statistical analysis using data from Bahrain, which is one of the leading economies in the Middle East. Testing this relationship in Bahrain is important because there have been a lot of efforts recently to support the presence of women on top corporate positions along with supporting the role of AI practices as part of Bahrain vision 2030.

Bahrain has set promising goals to improve and transform their economies beyond the dependence on fossil fuels. These goals are directed and supported with the employment of AI practices and innovative strategies following other developed countries that have already significant use of AI. The previous studies focused on testing the association between female directors, firms' performance and earnings management separately. However, none of these studies took into consideration the possible impact of AI application in these relationships, with exception to a few studies [13]. Hence, this study contributes to existing accounting and corporate governance literature and adds recent empirical evidence that can be used by practitioners and future research in the field of corporate governance, information technology and business management.

2 Literature review and theoretical framework

2.1 Board gender diversity and firms' performance

Corporate governance is the development of practices, rules, systems, and mechanisms that ensure the accountability of management, the direction of the firm, and improvement of firm performance. Gender diversity of board members is considered as one of the most important corporate governance issues. In recent decades, the number of female employees has increased substantially, and their roles and potentials have also changed [1]. As the board of directors in any company is the focal point and the reflection of the diversity of workforce in that firm, the diversity should also be seen in the board composition [14].

Theoretical perspectives of gender diversity and firm performance can be based on two main theories: the agency theory and the resource dependence theory, which emphasize the importance of greater board diversity on enhancing firm performance. On the other hand, role incongruity and the gender-stereotyping theory show a negative impact of female board directors on firm's performance [15].

Under the agency theory, a board that is diversified and consists of both genders is considered as the main essence of agency theory. This explains the board of directors' appellation in the monitoring and control

responsibilities. Hence, under the agency theory, gender diversity of the directors can reduce agency problems because of some cultural dimensions [16].

Furthermore, the agency theory explains an inherent imperfection in the relationship between capital providers (principals) and fiduciaries (agents) of that capital, where there is a divergency between the interests of managers (agents) and shareholders (principals) especially when the corporate management is separated from the corporate ownership [17]. The divergency and agency conflicts can be derived from asymmetric information, poor corporate governance and incomplete contracts, which lead to higher agency costs and poor performance [18]. As a result, the agency theory considers gender diversity of board members as a tool to improve performance and reduce any agency conflicts.

Corporate governance is yet another tool to reduce agency conflicts which is implemented through specific structures and mechanisms and board's design, mainly gender diversity. Agency theory explains the relationship between corporate governance and firm performance as well where strategists use gender diversity as a strategic tool to improve corporate governance practices, enhance board's independence, and reduce agency costs [19]. [20] debated that agency theory suggests that the presence of a diverse and balanced board that consists of both genders would improve corporate governance by preventing the dominance of an individual or a small group of individuals in the decision-making process.

The resource dependence theory is another theoretical foundation for gender diversity of the board where directors are viewed as a resource to the firm, and other stakeholders are strategically important to ensure firm's success. Under this theory, directors have a role to use their external network to gain and secure essential resources needed for the organization and operate and compete effectively. As a result, firms exercise substantial control over the external environment to obtain resources and survive [20].

This implies that the main proposition of the resource dependence theory is the need for environmental connections between the firm and external resources from the outside. Resources that can be obtained from the external environment include information, knowledge, channel establishment with working elements, organizational legitimacy, and the benefits that arise from board interrelation [21].

The presence of women on the board of directors can benefit the firm through a flow of skills, abilities and fresh perspectives and through building new dynamics to board deliberations [12]. As directors and executive act according to their personal experiences, personalities and human factors, female directors are known for their welcoming, gentle, respectful, and interpersonal experience more than men directors who are resilient, dominant, influential, dynamic, and goal oriented [15].

[22] justified three main reasons for the impact of gender diversity on firm performance. First, board gender diversity can help minimize the effect of "group thinking" that develops in homogeneous communities (such as a board of directors which consists of all male members). Second, female directors are generally seen as hard-working individuals and are known for their superior communication skills. Unlike male directors, female directors also have greater degrees and academic qualifications which in return would enhance the decision-making capacity and organizational performance. Third, female directors have diverse interests and wider social networks that build critical organizational factors and produce valuable resources.

On the other hand, the role incongruity theory was introduced by [23] to explain how and why people develop prejudice against female leaders at workplace. The prejudice and discrimination against females are extended from the fact that people have common expectations about their roles based on certain social categories, including demographic factors; occupations, academic background; or other relevant characteristics. As a result, the theory claims that negative assessments can be made when two different social roles are held by the same person. This theory is applied to understand the issue of gender-based prejudice in the workplace [24].

The role incongruity theory has stemmed many gender-stereotyping issues which gained massive interest in several empirical studies. A study showed that gender stereotypes were derived from the descriptive and injunctive norms of female gender roles which in return help in the rise of prejudice issues against female leaders as they involved the mismatch with other injunctive norms of leadership roles [25]. Moreover, these studies have also shown that women could have less access to leadership roles than men and face more obstacles as well. The prejudice issue exists against female directors albeit they have agentic behavior that matches the prescriptive requirements of the leadership role they applied for [23].

From a social perspective, social categorization, social responsibility, and social identification are also related to gender diversity where women are presented on the board and in the whole decision-making process. According to the similarity-attraction viewpoint, male directors prefer males over females for board positions as men opt to have more confidence and optimism than women at work [26].

The social identity theory, for instance, suggests that a highly heterogeneous group, where different skills and perspectives can be seen, negative effects are observed on communication and that group would have more difficulty in management with less efficiency in reaching consensus and decisions [27]. A study on US companies concluded that female presence on the board is negatively correlated to firm performance in social groups that are not pro-diverse [28]. Another study found that female directors are self-assured and follow their beliefs and concerns that can be contrary to the principles [29]. Another drawback for corporations when hiring female directors is the increased time needed to make decisions

in more diversified boards which negatively impact firm's performance [27]. The presence of a diversified board can also lead to additional costs which can be difficult to offset [30]. Turnover and non-attendance issues are yet other drawbacks of having female directors more than men directors [31].

Furthermore, researchers argue that corporate reputation is also directly linked to specific social and/or ethical responsibility issues based on the resource-based theory and the social identity theory [32]. Researchers argue that good reputation is linked to board diversity where analysts and institutional investors materialize firm's reputation based on its profitability and reduction in costs [33]. Diverse boards can promote better understanding of the marketplace, enhance the firm's reputation and allow for a broader view of the business environment [34].

Fortunately, reports regarding female board representation and firm performance have strengthened over recent years. Studies showed positive correlation between women presence on board of directors and performance measures such as return on sales, return on invested capital, and return on assets [35]. Another study showed the positive impact of a diverse board which demonstrated superior productivity, better financial performance, and higher financial ratios of return on equity, debt/equity ratios, price/equity ratios, and average growth [36]. A study using a large sample of 3000 US firms over the period 2007-2014 found that female directors have positive impact on firm's performance. This positive effect is larger in high-performing firms relative to low performing firms [37].

On the contrary, other studies showed differing views where female directors have detrimental or negligible impact on firm performance. Those studies found no significant link between female directors and the financial performance of major U.S. corporations, while other studies found a negative association and suggested that higher gender diversity on the board might lead to excessive governance in these firms, potential information deficits, risk aversion, and societal barriers women face [38]. Therefore, the relationship between gender diversity on boards and firms' performance is still vague and further investigation is needed. Due to the mixed findings of the previous studies, the direction of the first hypothesis was not specified and it was formed as follows:

H1. *There is a significant relationship between gender diversity on corporate boards and firms' performance.*

2.2 Artificial intelligence in the corporate world

In recent decades, research in artificial intelligence (AI) has focused on the issue of intelligent machines that can carry out certain tasks mainly associated with human intelligence. AI leverages computer systems and algorithms to use data, reason, and make informed decisions. These technologies are similar to cognitive functions that are found in humans, which can allow them to analyze data, automate processes, and provide support across different fields [39]. AI involves both the scientific discipline, and the technology aimed at building machines that can replicate human behavior, functions and intelligence [40].

Several studies discussed how AI affects a firm's performance. AI promotes the sustainable and effective use of resources [41]. Data-driven companies can enhance decisions and enable more precise predictions [42]. Specifically, an advanced digital transformation strategy creates knowledge from an existing large dataset [43]. Moreover, AI can enhance cost effectiveness and cost reductions which in return improves profitability. As a result, AI plays a vital role in autonomous decision-making processes, monitors assets and processes in real time, and enables value creation [44].

Although AI has the advantage of improving financial reporting, it can also lead to several negative effects such as: biases, lack of transparency, data privacy issues, and compliance challenges. Firms may have other issues as well such as: job displacement, training gaps, high implementation costs, interoperability challenges, and ethical issues. For overcoming these negative effects, firms should analyze and prioritize the different AI practices available, invest in data quality and governance, and address any potential biases in these practices. It is also crucial to stay well informed and updated about regulatory frameworks and ethical consideration. Hence, the next hypothesis is as follows:

H2. *There is a significant relationship between AI adoption and corporate performance.*

The role of female directors on the board could be influenced by the application of AI. It is believed that corporate board quality can be improved by using AI and gender diversity combined as one of the most critical factors of corporate governance. The application of AI can improve visibility and recognition of women leaders and identify their work in the industry. It can also improve the collaboration and mentorship as female directors can be connected, through AI, to other stakeholders with better networking opportunities [45]. In the AI sector, several reports note the importance of representations in the broadest sense for shaping women's views of themselves as potential future AI scientists, directors or entrepreneurs. Digital skills in the AI can enhance gender equality and promote the presence of women on the board which in return enhances firm's corporate governance [46].

Therefore, with the increasing attention on female directors on boards participation as well AI application in firms, this research investigates whether AI can moderate the relationship between gender diversity on corporate boards and financial performance. The study uses AI as a moderating variable that has not been tested before when linking the impact of female board directors and firms'

financial performance. Hence, the hypothesis was formed as follows:

H3. *AI application has a moderating role on the relationship between the gender diversity on corporate boards and firms' performance.*

2.3 Female directors and earnings management

Numerous researchers have attempted to formulate a general definition of earnings management; however, as observed by [47], the complexity of earnings management renders a comprehensive definition challenging. [48] definition, frequently cited by researchers, defined earnings management as managers' manipulation of reported earnings for personal benefit. The previous studies documented that female directors would enhance the monitoring system in firms. This could also be reflected in a reduction of the managerial manipulative practices.

Women monitor managers more efficiently [10] due to their reduced opportunism in decision-making pertaining to firms [49]. Women's active participation in boards meeting mitigates agency costs, thereby diminishing information asymmetry [50], which may aid in preventing fraud in companies [51]. Accordingly, it can be assumed that the presence of female directors would help in better monitoring of managerial opportunistic practices, and this would significantly affect earnings management practices. However, the previous studies' findings are still mixed with regards to the influence of female directors' presence on firms' earnings management. For instance, [10] found that the presence of female directors would reduce earnings management practices. On the other hand, [12] findings indicated a negative and significant correlation between the inclusion of women on boards and earnings management. The next hypothesis is formulated as follows:

H4. *There is a significant relationship between gender diversity on corporate boards and earnings management practices.*

Lastly, as stated earlier, AI applications could help in improving the monitoring and decision making of firms as it plays a vital role in autonomous decision-making processes, monitors assets and processes in real time, and enables value creation [44]. Besides, data-driven companies can enhance decisions and enable more precise predictions [42]. Furthermore, as stated by [40], AI technology could aid female directors in overseeing the precision and efficacy of financial reports. In addition, it may help in detecting potential discrepancies in the financial statements of a business and it can facilitate the detection of possible frauds. Therefore, this research investigates whether AI can moderate the relationship between gender diversity on corporate boards and earnings management. Therefore, the next hypothesis is:

H5. *AI application has a moderating role on the relationship between the gender diversity on corporate boards and earnings management.*

3 Materials and Methods Study sample

Bahrain has continuously positioned itself as a key hub for technological advances in the financial sector [52]. Bahrain has made substantial strategic decisions in artificial intelligence over the last 15 years, aligning with its plans for a knowledge-based and digital economy [53]. Moreover, Bahrain has continuously supported initiatives to enhance the presence of female directors in corporate boards.

The corporate governance regulations were recently revised by the CBB Governor with the aim of augmenting the representation of women on boards of joint stock companies listed on the Bahrain Stock Exchange. The listed corporations must consider the presence of female directors and reveal the gender related information in their yearly reports. Given Bahrain's distinctive social, cultural, and financial attributes, it is considered suitable research setting to investigate the study goals, given the continuous progress in improving artificial intelligence services in the financial sector and increasing the presence of women on boards.

The research sample comprised financial sector companies listed on the Bahrain bourse, specifically banks and insurance companies. The aggregate number of listed companies in the financial sector is 20. One firm was excluded from the sample due to suspension, and accordingly, the study sample consisted of 19 banks and insurance companies and a total of 133 observations for the years 2017 to 2023. The data was mainly collected from the firm's annual reports. Given the variations in regulations between financial and non-financial listed firms, the present study specifically concentrated on financial firms. Figure 1 represents the conceptual framework related to the current study.

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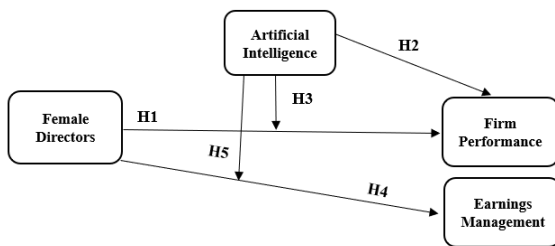

Figure 1: Conceptual Framework.

3.2 Model development

The current study applied fixed effects model. The previous studies that analyzed panel data employed fixed effects to account for endogeneity and hidden heterogeneity in time-invariant and firm-specific features when examining the relationship between the presence of female directors and firms' outcomes [e.g., 21; 53]. To investigate if the percentage of women directors is linked with firms' performance as well as earnings management. Also, to test if artificial intelligence is moderating these two relationships, the following regression models were created:

$$ROA_{i,t} = \alpha_0 + \alpha_1 W\_B + \alpha_2 LEV_{i,t} + \alpha_3 F\_SIZE_{i,t} + \alpha_4 B\_SIZE_{i,t} + \alpha_5 AI_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$ROA_{i,t} = \alpha_0 + \alpha_1 W\_B + \alpha_2 AI_{i,t} + \alpha_3 W\_B \times AI_{i,t} + \alpha_4 LEV_{i,t} + \alpha_5 F\_SIZE_{i,t} + \alpha_6 B\_SIZE_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$EM_{it} = \alpha_0 + \alpha_1 W\_B + \alpha_2 LEV_{i,t} + \alpha_3 F\_SIZE_{i,t} + \alpha_4 B\_SIZE_{i,t} + \alpha_5 AI_{i,t} + \varepsilon_{i,t} \quad (3)$$

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Where:
Return on assets (ROA) is an accounting metric that evaluates the performance of companies by calculating the ratio of net revenue to total assets. Earnings management (EM) is quantified using the modified Jones model by [57]. Artificial Intelligence (AI) is a disclosure-oriented metric derived from prior research [68]. $\varepsilon_{i,t}$ represents the error term. i represents firms, t represents the period. The independent variables in the aforementioned models are described in table 2.

The measurement of study variables: The study specifically examines the involvement of women directors, as the board bears responsibility for any shortcomings in monitoring financial reporting [69] and serves as the main entity responsible for formulating decisions regarding companies' strategy [59]. Hence, it is imperative to examine the potential influence of women's representation on boards on the financial condition of enterprises as well as the manipulation practices. Consistent with prior research, gender diversity is assessed by calculating the percentage of women directors [10].

In line with most prior research, the dependent variable employed in this study was ROA as an accounting metric [11]. Furthermore, the second dependent variable is EM which is measured using a modified Jones model developed by [57]. This model is frequently employed in prior research to assess accrual-based EM [54,58].

Furthermore, in line with previous research [56], companies can alter their earnings either upward or downward. However, the purpose of this study is to examine whether there is an EM or not, instead of determining the EM direction. Therefore, the present study specifically assessed the absolute value of residuals associated with the model. A higher absolute value of the model residuals indicates a greater level of EM [61].

Furthermore, based on previous research, the artificial intelligence proxy is assessed by a checklist of artificial intelligence-related terminology extracted from companies' annual reports [60]. This proxy measures the frequency of artificial intelligence-related terms in the annual reports of companies [55,68]. Following [68], the checklist was divided into three main sections. The first section includes keywords to measure digital awareness,

transformation, and capabilities. The second section measures the AI application, product service and process and the final section focuses on AI information challenges and cyber security threats. The keywords are represented in table 1.

Based on earlier studies [54,67], the control variables incorporated in this study were the size of the company, financial leverage, and the size of the board. Previous research has demonstrated that firm size could be a predictor of company performance, as bigger companies generally exhibit superior performance over smaller companies attributable to their increased industry influence [63]. Moreover, some risks faced by a company are influenced by its level of leverage as a firm faces a greater likelihood of bankruptcy when its ratio is high [63].

4 Results and Discussion

Descriptive statistics The results of the descriptive statistics analysis are presented in Table 3. Table 3 indicates that certain corporate boards lacked female directors, with an average representation of 4.7%. This percentage is comparatively low in comparison with other countries globally. Furthermore, the mean ROA is 0.015. The ROA illustrates management's proficiency in utilizing shareholders' corporate assets [64]. [64] asserted that a diminished ROA indicates suboptimal firm management. Moreover, concerning earnings management practices (EM), the table indicates an average of 0.036, suggesting that firms are employing income-increasing strategies to boost their earnings. The average frequency of AI-related terms is 15, which is comparatively low and suggests that further efforts are necessary to integrate AI practices within Bahrain's financial sector.
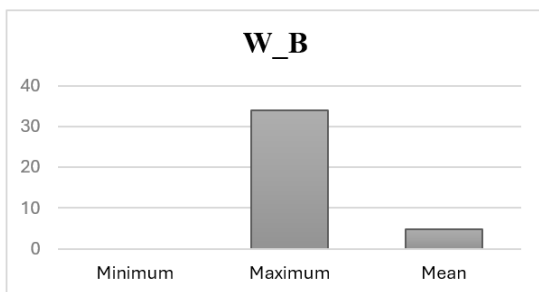

Figure 2: Descriptive statistics related to the percentage of female directors on board (W_B).

Data analysis Table 4 displays the Pearson correlations results. The Pearson correlation coefficient
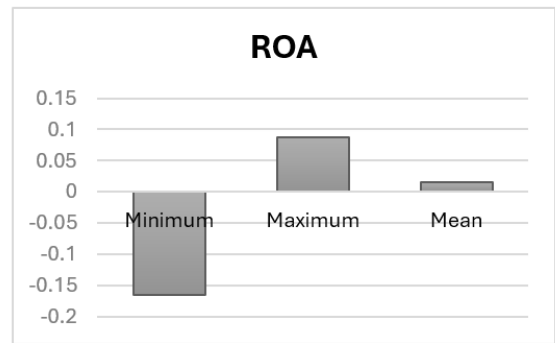

Figure 3: Descriptive statistics related to the return on assets (ROA).
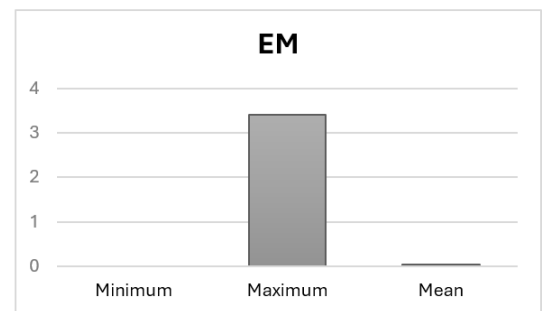

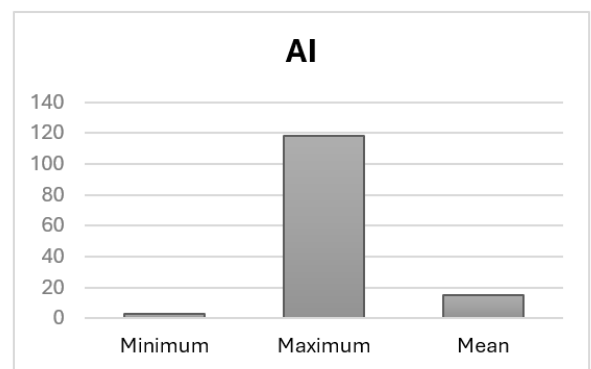Figure 4: Descriptive statistics related to the level of earnings management (EM).

Figure 5: Descriptive statistics related to the AI disclosure.

evaluates the significance of the relationship between two variables, disregarding any additional control variables. This test is employed to assess multicollinearity; [62] indicated that a correlation exceeding 0.9 may suggest multicollinearity problems within a model. Table 4

Table 1: Keywords included in AI related disclosure checklist

Checklist section	AI related disclosure keywords
Digital awareness, transformation, and capabilities	"digital transformation", "fintech", "financial technology", "modern technology", "AI digital strategy", "latest technology", "advanced technology", "AI computing technology", "digital infrastructure", "digital library", "electronic channel", "electronic system", "internet of things", "5g technology", "advanced technical experiences", "digital platform", digital technology", " 5g networks", "blockchain", "smart connection", "digital awareness", "digital capabilities", "digital culture", "digital economy", "digital futuristic", "digital transition", "augmented reality technology", "technical platform", "web technology", "machine learning", "deep learning", "augmented intelligence", "natural language processing (NLP)"
AI application, product service and process	"robotics", "robo-advisors", "automation", "digital banking", "mobile banking", "online banking", "digital services", "mobile apps", "electronic payment", "internet banking service", "mobile branches", "mobile payment", "robots", "mobile ATMs", "digital payment", "digital identity", "smartphones", "smart bank websites", "digital product", "electronic service", "intelligently analyses", "digital wallet", "electronic wallet", "mobile device service"
AI information challenges and cyber security threats	"information security", "cyber security", "electronic security", "it risks security", "electronic security policies", "card security", "cyber risk", "electronic security", "cybercrime", "bank electronic security", "customized electronic security methods", "cyber intelligence", "electronic attack", "global security", "information security breaches", "security vulnerabilities"

Table 2: Study models' variables' description.

Variable	Definition	Measurement
W_B	The percentage of female directors	Total number of women directors divided by total number of board members.
ROA	Return on assets	Ratio of net revenue to total assets.
EM	Earnings management	Absolute value of the discretionary accruals calculated by using the residuals of the modified Jones model.
AI	Artificial Intelligence	The number of artificial intelligence-related terms disclosed in the annual reports of companies.
LEV	Firm leverage	Total liabilities divided by total assets.
F_SIZE	Firms' size	The natural logarithm of total assets.
B_SIZE	Board Size	Total number of board members.

Table 3: Descriptive statistics.

Variable	Minimum	Maximum	Mean	Stand. Dev.
W_B	0	34	4.712	14.27
ROA	-0.165	0.088	0.015	0.072
EM	0	3.409	0.036	0.349
AI	3	118	15.038	5.745
LEV	0.199	21.263	4.182	5.634
F_SIZE	0.094	8.028	5.493	1.497
B_SIZE	4	12	8.023	2.495

indicates that all relationships are below 0.9. In addition, the variance inflation factor (VIF) test was employed to assess the multicollinearity problem. A VIF value exceeding 10 generally signifies a strong relationship between the independent variables [65]. Table 4 indicates that the VIF values are below 10, implying the lack of multicollinearity that could affect the model outcomes.

Subsequently, Table 5 presented the findings of the regression analyses concerning the correlation between board gender diversity and corporate performance (ROA model), as well as earnings management (EM model). As can be seen in table 5, the ROA model indicates a significant positive correlation between ROA and W_B at the 5% level, suggesting that the inclusion of female directors enhances firms' profitability. The finding aligns with the findings of [35] and [1].

The results support [34]'s argument that board gender diversity can promote better understanding of the marketplace, enhance the firm's reputation and allow for a broader view of the business environment, which can positively influence firms' financial performance. Moreover, as demonstrated in the EM model, table 5, a significant negative correlation at the 5% level exists between board gender diversity and earnings management practices. This indicates that the inclusion of female directors is likely to improve board oversight, thereby reducing opportunistic managerial behaviors. The result agrees with the findings of [10].

The result aligns with agency theory and previous research' assertion that female directors possess superior observing abilities, that facilitate effective oversight by the board, enhance company performance, and increase the value of shareholders [11]. The findings also corroborate the assertions of resource-dependence theory, which posits that the appointment of female members is crucial for enhancing company profitability and success, as women may promote the utilization of vital external resources and provide greater value to assets [22]. Therefore, H1 and H4 are accepted.

Furthermore, the correlations between AI practices and ROA and EM are significantly positive and significantly negative at the 5% level, respectively, suggesting that AI solutions would positively enhance the profitability of companies while enhancing their monitoring systems. The findings corroborate the argument of [66] that AI can reduce transaction costs and mitigate asymmetry of information, ultimately leading to improved company profitability and a decrease in manipulative practices.

Furthermore, as emphasized by [53], AI can augment information disclosure to boost integrity and diminish disparities among various stakeholders, ultimately prompting companies to improve profitability and mitigate earnings management. Also, the finding is in alignment with [41] suggestion that AI promotes the sustainable and effective use of resources which eventually would affect firms' performance. The findings are in alignment with [53]. Consequently,**H2** is supported.

To ascertain whether AI exerts a moderating influence on the relationship between gender diversity and company performance, as well as earnings management, the AI variable was incorporated as a moderator in the regression models presented in Table 6. The moderating impact of AI was substantial (W_B×AI), as indicated in both the ROA and EM models. The moderating variable (W_B×AI) significantly and positively influenced the correlation between gender diversity and firm performance at the 1% level. The (W_B×AI) variable in the EM model exhibited a negative and statistically significant relationship at the 5% level. This indicates that AI has successfully correlated female directors with firm performance and earnings management. Furthermore, female directors employ various mechanisms for oversight and decision-making, including the use of AI application tools, which yielded a significant correlation. Furthermore, the results support [46] argument regarding that AI can enhance gender equality and promote the presence of women on the board which in return enhances firm's corporate governance. Also, the finding confirms what stated by [40] which is that AI technology could aid female directors in overseeing the precision and efficacy of financial reports. In addition, it may help in detecting potential discrepancies in the financial statements of a business and it can facilitate the detection of possible frauds. Therefore, **H3** and **H5** are accepted.

5 Conclusion

In conclusion, the study intended to investigate the influence of gender diversity on corporate boards on corporate performance and earnings management practices, as well as the extent to which AI applications could serve as a moderating factor in strengthening the connection. This is attributable to the significance of corporate governance methods and the evolution of the global landscape towards the adoption of AI advancements within the financial services sector. The study sample comprised 19 financial firms listed on the Bahrain Bourse from 2017 to 2023.

Our findings indicate that women directors positively influence the performance of companies, while negatively impacting earnings management practices. This conclusion is corroborated by the prevailing agreement that women and men exhibit differences in psychological, biological, and social aspects, which can enhance company productivity and oversight [10]. The finding is consistent with the results of [35] and [1]. The result corroborates agency theory and prior research's claim that female directors exhibit enhanced observational skills, which promote effective governance by boards, improve company performance, and elevate shareholder return [11]. The results further validate the claims of resource-dependence theory, which asserts that the inclusion of female members is essential for improving company earnings and success, as women may facilitate

Table 4: Pearson Correlation and VIF values

Variable	W_B	ROA	EM	AI	LEV	F_SIZE	B_SIZE	VIF
W_B	1							3.657
ROA	.125	1						—
EM	.256	.496**	1					—
AI	.241	.443**	.331*	1				2.984
LEV	.127	.392*	.598**	.325*	1			3.274
F_SIZE	.293	.364*	.446**	.223	.485**	1		2.828
B_SIZE	.142	-.023	.002	-.128	-.014	.210	1	1.256

*, ** Correlation is significant at the 1% level and at 5% level respectively.

Table 5: The relationship between female directors and firms' performance and earnings management.

Variables	ROA		EM	
	Coef.	t-statistic	Coef.	t-statistic
Constant	.493	6.282***	.184	2.319**
W_B	.350	2.130**	-.033	-2.581**
AI	.719	2.154**	-.044	-2.258**
LEV	-.296	-.250	.003	.230
F_SIZE	.778	.641	.025	1.818*
B_SIZE	.515	2.136**	.052	3.524***
YEAR	Included	Included	Included	Included
FIRM	Included	Included	Included	Included
Adj. R2	.283		.324	
F	50.305		66.639	
Observations	133		133	

***, **, * represent significance at the 1%, 5% and 10% levels, respectively.

Table 6: The moderating role of Artificial Intelligence.

Variables	ROA		EM	
	Coef.	t-statistic	Coef.	t-statistic
Constant	.581	6.162***	.194	2.346**
W_B	.364	2.183**	-.160	-2.430**
AI	2.327	1.789*	-.148	-3.542***
W_BxAI	.470	1.877*	-.083	-2.750**
LEV	.069	.053	-.150	-3.589***
F_SIZE	1.089	.839	.014	.216
B_SIZE	2.003	1.495	.081	2.575**
YEAR	Included	Included	Included	Included
FIRM	Included	Included	Included	Included
Adj. R2	.294		.3192	
F	63.048		64.294	
Observations	133		133	

***, **, * represent significance at the 1%, 5% and 10% levels, respectively.

the use of critical external resources and enhance asset value [22]. Besides, the presence of female directors is crucial for improving firms' performance and success, as they contribute additional valuable knowledge [22].

The research identified a substantial positive correlation between AI and corporate performance, as well as a notable negative correlation between AI and earnings management. The results support [66] assertion that AI can mitigate significant transaction expenses and information asymmetry, thus enhancing corporate profitability and diminishing manipulative practices. The

study revealed that AI plays a substantial moderating role in influencing the relationship between gender diversity and firm performance, as well as between gender diversity and earnings management. This affirms that advancements in AI assist female directors in making informed decisions regarding oversight and profitability of companies. The results are in alignment with [46] who agreed that AI technology can assist female directors in ensuring the accuracy and effectiveness of financial reports. Furthermore, it may assist in identifying potential

discrepancies in a company's financial statements and facilitate the detection of possible fraud.

The study provides significant contributions to literature in various aspects. This study is, to our knowledge, the first to examine AI adoption as a moderating variable, a continually evolving factor in Bahraini financial institutions. Second, the study's findings offer robust and contemporary evidence concerning the influence of gender diversity on corporate performance and earnings management; previously, the results were inconclusive and ambiguous regarding these two relationships. The present study offers significant insights and practical implications concerning corporate performance, earnings management, and advancements in AI solutions within a developing nation.

The study offers numerous practical implications for policymakers and regulators in Bahrain and GCC nations concerning the possibilities for women in top firms' positions and the advancement of AI. Policymakers ought to promote the appointment of additional women to the boards of directors of publicly traded companies, given their beneficial influence on business performance. Additionally, they could implement a quota concerning the ratio of women to men and incentivize companies that are striving to diversify leadership roles within their organizations. Furthermore, regulators ought to implement compliance policies to facilitate the adoption of AI in the financial sector, as the Bahrain Fintech hub is emerging as the largest hub in the Middle East, benefiting numerous stakeholders in the region. In addition, companies should use more AI solutions to enhance the board monitoring process and improve corporate governance.

Companies can dedicate funds to create AI-driven solutions designed to assist directors in making decisions, concentrating on aspects such as uncovering potential fraud practices. Also, companies should make sure to have IT governance committee that could make sure that the AI is used properly and not misused. Also, stakeholders should take into account whether a firm includes female directors and apply AI solutions when taking a decision. Furthermore, the pivotal role of AI in strengthening the influence of female directors indicates an increasing necessity for the incorporation of modern technologies in the governance of companies. This underscores the capacity of AI tools to support female board members' decisions, thereby advancing governance outcomes.

Nevertheless, the study is not devoid of certain limitations, similar to prior research. The study took place in a single country, which restricts the generalization of the results. Subsequent research may investigate similar hypotheses concerning GCC nations. Secondly, we have conducted the study exclusively on the financial sector, excluding non-financial ones due to regulatory disparities. New studies may examine both sectors. Third, ROA was incorporated into the analyses to assess firms'

profitability; future studies may utilize alternative metrics such as ROE or Tobin's Q.

Furthermore, this study focused on the accrual method of earnings management, while future research may explore real earnings management or the misclassification of income statement items. Fourth, subsequent research could examine the factors influencing AI adoption in GCC countries. The present study employed a fixed effect regression method for data analysis; however, alternative econometric techniques, such as 2SLS or GMM regression, and the instrumental variable method, could have been utilized to address the problem of endogeneity.

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