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Do Stable Banks Disclose More Climate Risk? Governance Evidence from the MENA Region

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Abstract

The current study aims to identify the factors influencing the disclosure of climate-related risk information by the MENA banking sector and how bank financial stability acts as a moderator. The study draws from agency theory, resource dependency theory, and organizational legitimacy theory. Textual analysis is used to analyze a panel data set comprising 46 banks of 13 MENA countries for the years 2020 to 2024 (230 observations). We investigate the impact of board independence, board size, and gender diversity on climate risk disclosure. It is found that while board size and gender diversity have a positive effect on CRD, there is no direct effect of board independence on CRD. However, after taking bank financial stability (Z-score) into account as a moderating variable, it is revealed that there is a significantly positive relationship between board independence and bank financial stability. Therefore, it can be said that independent board members are helpful in CRD only when banks have sound financial stability. This study provides various robustness tests through subsample analysis and alternative methods of estimating model parameters.

Keywords: MENA region; board size; board gender; board independence; climate risk disclosure; bank stability

1. Introduction

Climate change poses systemic risks to global financial stability, necessitating transparent disclosure practices to mitigate information asymmetry and strengthen market discipline (Albitar & Gerged, 2026; de Bandt et al., 2025; Ilhan et al., 2023). As climate-related physical and transition risks threaten asset quality and long-term sustainability, regulators increasingly emphasize CRD as a critical mechanism for resilience (IPCC, 2023). While the banking sector plays a pivotal role in financing the transition to a low-carbon economy, empirical evidence regarding the determinants of CRD remains limited, particularly within emerging markets characterized by distinct institutional vulnerabilities (Yahya & Lee, 2026). Climate risk is the exposure of businesses to possible negative consequences resulting from climate-related business transactions, while CRD refers to how businesses are exposed to the hazards associated with climate change, how they manage those risks, and what tactics they employ. Therefore, it is necessary for banks to disclose information that is related to climate risk based on the legitimacy and agency theories (Faisal & Abboud, 2026; Giannetti et al., 2026).



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CRD has become important to financial institutions due to increasing external pressure for banks to respond to climate change-related risks and opportunities. In response to potentially significant financial, operational, and long-term implications for financial institutions, transparency and corporate responsibility are often considered key elements for strengthening the stakeholders' confidence through robust CRD practices. Previous empirical evidence indicates that effective corporate governance mechanisms, auditors' quality, and robust risk management processes enhance the disclosure quantity and quality. Proactively acting audit committees, as well as climate-related knowledge of auditors, positively affect disclosure quality and frequency. Moreover, more disclosure is linked with more conservative accounting in order to cope with the uncertainty related to climate change issues (Dahmen & Chouaibi, 2024; Khalifa et al., 2023; Pham et al., 2024).

Besides the aforementioned factors, there might be significant impacts from firm-level factors (corporate governance) on corporate climate transparency. There is substantial empirical evidence that board characteristics such as diversity, independence, expertise, and overall performance may help companies to deal with climate change issues and report effectively about their risks. Corporate boards can be successful in promoting climate initiatives, complying with climate reporting guidelines, and having effective sustainable disclosures provided they have varied experience and practice good corporate governance (Dias et al., 2026; Gebhardt et al., 2024; Lippi & Galavotti, 2024; Nguyen et al., 2022). Moreover, the involvement of women on board- and executive-level management seems to foster increased commitment to managing climate-related risks, enhance climate-related disclosure transparency and improve organizational resilience toward climate change risks (Caby et al., 2022; Hossain et al., 2017).

Apart from the firm-level issues, climate risk has become a significant concern related to financial stability especially within the banking sector. It has been argued that CRD helps to mitigate information asymmetry and strengthen financial stability (Nieto, 2019), while climate risk exposure can negatively affect banks through an increase in loan loss provisions, liquidity pressure, or higher non-performing loans. It appears that such risks may be more prevalent among small banks with limited capitalization (Pham et al., 2024; Zhu et al., 2026). As such, a significant proportion of banks (more so within developing countries) are likely to embrace a prudent accounting stance in response to the growing threats of climate-related risk (Khalifa et al., 2023).

Conversely, the second stream of literature incorporates alternative and supplementary perspectives that broaden the criteria of disclosure. Zhang et al. (2025) and Ilhan et al. (2023) explore the association between climate risk and technological innovation in renewable energy, emphasizing enterprises' strategic initiatives rather than solely their disclosure practices. Additionally, Berkman et al. (2024) utilize external proxies, including the Global Climate Risk Index, to evaluate climate risk exposure, thereby offering an alternative methodological framework to disclosure-based approaches. These studies collectively enhance the field by linking climate risk to innovation outcomes and alternative risk assessment frameworks.

The research demonstrates that board of director (BOD) governance frameworks improve monitoring and transparency in CRD by coordinating management actions with stakeholder expectations and public pressures via the use of agency and legitimacy theories. Stable banks may make better disclosures and spend more in long-term sustainability projects (Dias et al., 2026; Gebhardt et al., 2024; Namanya et al., 2021). According to managerial power theory, financial instability might compromise the efficacy of governance by enabling managers to control BOD choices and conceal unfavorable climate-related facts (Dahmen & Chouaibi, 2024). On the other hand, financial stability increases the credibility of disclosures and strengthens board monitoring (Khalifa et al., 2023; Nieto, 2019). The

relation between corporate governance and CRD is strengthened by bank stability, which makes it possible for boards to manage CRSs more effectively.

However, comprehensive examination of the MENA region reveals substantial institutional diversity, particularly between the economically stable Gulf Cooperation Council (GCC) countries and the more unstable non-GCC nations, such as Lebanon, Iraq, and Palestine. This implies that the consideration of country-specific institutional attributes is necessary due to the existence of varying governance mechanisms. Furthermore, the interaction between board characteristics and bank stability in relation to CRD remains underexplored, despite the fact that corporate governance has been identified as a factor influencing disclosure (Kılıç & Kuzey, 2019). The Middle East and North Africa (MENA) regions are facing significant challenges due to environmental issues such as water scarcity and rising temperatures, along with a reliance on hydrocarbon resources. These challenges increase the likelihood of climate shocks, threatening the social and economic frameworks necessary for financial stability (Namdar et al., 2021). Consequently, the transparency of the banking sector is essential for bolstering regional resilience. However, there is a notable lack of comprehensive data on carbon emissions and CRD among MENA banks (Waha et al., 2017). Existing research acknowledges corporate governance as a factor influencing disclosure practices, yet there is insufficient examination of how specific board characteristics—like size, independence, and gender diversity—affect bank stability and, subsequently, CRD in this context (Kılıç & Kuzey, 2019).

The research examines the determinants of CRD from a corporate governance perspective within the MENA region banking sector, specifically analyzing the moderating influence of bank stability. This study contributes to the literature by examining a sample of 46 publicly traded banks from 13 MENA countries between 2020 and 2024 in three distinct ways. First, it provides distinctive empirical evidence concerning the specific factors influencing CRD in a highly affected region, in addition to general environmental, social, and governance (ESG) metrics. Second, it includes bank stability in the governance disclosure related to determining if financial strength enhances the effect of board characteristics on transparency more significantly. Third, it provides regulators with recommendations about how to make disclosure regulations aligned with international frameworks like the Task Force on Climate-related Financial Disclosures (TCFD), particularly by providing several recommendations that can enhance compliance and improve overall transparency in financial reporting.

The remainder of this paper is organized as follows: the second section provides the literature and hypothesis development; the third section outlines the research methodology; the fourth section presents the statistical analysis; and the fifth section provides the results. The last section presents the conclusion, limitations, and policy implications.

2. Literature Review and Hypotheses Development

2.1. Theoretical Background: Climate Risk Disclosure and Reporting Frameworks

Prior to the synthesis of the literature, it is vital to make the conceptual distinction between CRD and wider constructs like general ESG reporting, carbon emissions or environmental performance in general. While ESG disclosure covers a range of social and governance metrics, carbon emissions represent one output dimension of environmental performance. CRD is a specific forward-looking narrative disclosure about the way an organization identifies, assesses, and responds to the financial impacts of both physical and transition climate risks (Bingler et al., 2022; TCFD, 2017). The analysis conducted here deliberately restricts itself to CRD in its direct focus on the information asymmetry on climate-related financial risks to the stability of banks as opposed to their general performance.

Recently, CRD has undertaken significant growth, driven by the increasing need for consistent, comparable, and decision-useful information for investors and other stakeholders. This increase reflects the rising realization that climate change presents significant financial threats to organizations' strategy, risk management, and financial performance. From the standpoint of stakeholder and legitimacy theory, corporations face increasing pressure to disclose climate-related information to fulfill social expectations and sustain legitimacy within capital markets. A major step toward harmonization has been the consolidation of leading sustainability reporting initiatives into a unified global framework. Prominent organizations, including Climate Disclosure Standards Board, Sustainability Accounting Standards Board (SASB), and the Task Force on Climate-related Financial Disclosures (TCFD), have played a foundational role in shaping modern climate disclosure practices (Principale & Pizzi, 2023; TCFD, 2017). Each framework shaped climate disclosure procedures. CRD has facilitated disclose more environmental information including carbon emissions, water use, and deforestation. CDSB also stressed the need for environmental information in financial reporting, linking sustainability and financial achievement (IFRS, 2022). SASB also created industry-specific criteria on financially important sustainability concerns, making disclosures more relevant to investors. Based on these efforts, the TCFD created a governance, strategy, risk management, and metrics and objectives framework that has become the worldwide standard for climate-related financial disclosure.

Based on the below literature, the following theories are combined in order to be used in presenting a consistent theoretical framework: The agency theory of Fama and Jensen (1983) suggests that an autonomous and diversified board monitor the opportunism of the management and, hence, enable disclosure of the CRD. Legitimacy theory and stakeholder theory by Albitar and Gerged (2026) identify the reasons of banks for disclosing climate risks, publicly enabling banks to survive. Resource dependence theory, as explained by Fitrasari (2023), demonstrates how board size and board diversity contribute to supplying the necessary external resources needed in disclosures on climate risks according to the TCFD. Finally, RBV theory addresses the aspect of bank stability that provides a resource for financial stability that enables banks to govern well because banks are not compelled to survive (Abdul Karim et al., 2019; Nieto, 2019).

The International Sustainability Standards Board (ISSB) is crucial to global comparability and standardization. IFRS S1 and S2 are steps toward a unified investor-focused reporting structure. While IFRS S1 offers a fundamental framework for sustainability-related financial reporting, IFRS S2 expands on the TCFD recommendations to address climate change risks and opportunities. These rules require enterprises to disclose physical and transition threats, greenhouse gas emissions, and climate change's financial impacts. This opens financial markets and reduces information inequality (IFRS, 2023). Standardized disclosures mitigate information asymmetry between managers and investors, enhancing market efficiency and decision-making, as posited by agency theory. Companies must transparently disclose their environmental performance to combat climate change and mitigate climate risk (Berkman et al., 2024).

Stakeholders, like activist investors, ESG rating providers, and shareholder advocates, give companies more reasons to share more social and environmental information. Disclosures about climate change are also helped by social media, ESG rating services, and activist institutional investors. Climate change and sustainability proposals from shareholders can change what companies say, even if the plans are later withdrawn (Almulhim & Metwally, 2025; Alomair & Metwally, 2025; Chandrakant & Rajesh, 2023; Metwally et al., 2025a, 2025b; Saha & Khan, 2024). Shareholders also give companies more reasons to improve the quality of their disclosures because they credit companies that work together to make disclosures better. This kind of cooperation might encourage other companies to give better reports.

Companies that do not want to talk about their climate risks have a higher cost of stock than companies that do. This is because the market thinks that these risks are important. Auditors are a big part of disclosure that goes beyond financial records. They check to see if climate risk is properly included in financial reporting and push for better quality climate risk reporting (Kouloukoui et al., 2019).

The literature on CRD is rather extensive, and can be summarized by two main lines, which are based on different assumptions. The first stream emphasizes the effect of corporate governance mechanisms, specifically the nature of the board, on the practices of climate-related disclosures. Several research reports suggest that specific board characteristics, including gender diversity, independence, size, age and expertise, are key in fostering transparency and accountability in the reporting of climate risks. In previous studies such as those by Dias et al. (2026) and Gebhardt et al. (2024), it is indicated that with better governance structures, there would be more convergence between the companies required to disclose climate information and their outcome. Further studies like Lippi and Galavotti (2024) and Nguyen et al. (2022) provided another stream of evidence which found that better board diversity and structure leads to more comprehensive climate change policies and better disclosure practice. In line with the above findings, earlier studies also demonstrated that board- and top management-level gender diversity have a positive impact on climate change management and disclosure (e.g., Hossain et al., 2017) and board and top management gender diversity on boards strengthens companies against climate shocks in terms of financial performance (Caby et al., 2022), consistent with the conclusions of Nguyen et al. (2022) and Nieto (2019) as climate risk exposure on financial stability (in particular, on the banking sector) and financial welfare. In addition, Khalifa et al. (2023) noted that banks in developing countries have accounting behaviors of conservatism because of climate risk (as a sense of precaution against uncertainty).

A second source of information was from the second branch of the literature, which added the dimension of disclosure. Zhang et al. (2025) and Ilhan et al. (2023) examined the relation of climate risk and innovation in the field of renewable energy technologies, and Berkman et al. (2024) analyzed climate risk exposure outside measures rather than based on disclosure, and not only firm accounting disclosure behavior but also firm strategic options were analyzed by both papers. These were another group of coordinated studies in order to enhance the body of knowledge to link climate risk and innovation performance together and provide a new way to measure climate risk.

According to activist investors, ESG rating agencies, and shareholder organizations, companies must enhance their social and environmental disclosures, particularly regarding climate change. Social media and activist investors influence these disclosures, including modifying firm responses to shareholder proposals, irrespective of any later retraction (Saha & Khan, 2024). Moreover, shareholders incentivize companies that collaborate to enhance the quality of disclosures. Another firm may enhance its reporting after the observation of this collaborative methodology. Market perceptions of climate risks inflate stock valuations for corporations that fail to recognize them. Auditors should promote enhanced climate risk disclosure in financial statements (Kouloukoui et al., 2019).

H1. *Board characteristics (size, independence, gender, and nationality) have a significant effect on climate risk disclosure in MENA region banks.*

2.2. Board Characteristics and Climate Risk Disclosure

2.2.1. Board Size and Climate Risk Disclosure

According to resource dependence theory, board size is a vital governance characteristic that can augment a firm's access to external resources, such as expertise, legitimacy,

and stakeholder relationships, thereby enhancing its environmental and sustainability performance (Fitrasari, 2023). Larger boards, within the framework of ESG practices, are anticipated to promote increased independence, diversity, and stakeholder representation, thereby improving oversight of sustainability-related concerns, such as climate risk and carbon emissions. Recent empirical studies substantiate this argument; for example, Mohamed Buallay et al. (2023) identify a positive correlation between board size and ESG performance, indicating that larger boards enhance sustainability disclosure and environmental accountability, particularly in emerging markets as firms with larger boards exhibit lower carbon emission intensity and directors with diverse backgrounds promote more responsible environmental decision-making. Zhang et al. (2025) and Li et al. (2024) also note that companies with bigger boards are more likely to make detailed Corporate Responsibility Disclosures (CRDs) and use advanced carbon management strategies. This is because the board has a wide range of skills and is under pressure from stakeholders.

However, despite these positive findings, several studies highlight the potential disadvantages of larger BOD. Based on the agency theory, several studies argue that large boards may lead to coordination problems, slower decision-making processes, and increased conflicts among directors, which can weaken governance effectiveness. In the context of ESG and climate-related outcomes, this may translate into symbolic rather than substantive disclosure practices. Empirical evidence supporting this view is provided by Ogiemwonyi et al. (2023) and Elamer et al. (2024), who find a negative relationship between board size and ESG performance, suggesting that larger boards may suffer from inefficiencies that limit their ability to effectively oversee sustainability initiatives. Similarly, Sbai and Ed-Dafali (2023) report that larger boards are associated with weaker CRD in certain institutional contexts, as information asymmetry and free-rider problems reduce monitoring quality.

Despite the increase in the related literature, notable gaps persist in understanding the relationship between board size and carbon risk disclosure (CRD) in sustainability frameworks. Previous research primarily concentrated on board size and ESG performance, lacking focus on CRD, particularly after global standards like IFRS S2. Additionally, empirical studies connecting board size with carbon emissions performance and climate risk disclosure are sparse, especially in developing countries and the MENA region. There is also a lack of investigation into how board size interacts with firm-specific factors, such as financial stability, to affect climate-related outcomes. This study aims to fill these gaps by providing empirical evidence concerning the relationship between board size and CRD in the MENA region.

However, despite the growing number of academic papers on this topic, many knowledge gaps remain open concerning the institutional context under which the hypothesis was developed. Even though research from an international perspective emphasizes that larger boards can create some potential coordination problems (Ogiemwonyi et al., 2023; Sbai & Ed-Dafali, 2023), MENA banks operate in the institutional void of limited mandatory climate-related regulation and more flexible frameworks for decision-making compared to developed countries (Kılıç & Kuzey, 2019; Namdar et al., 2021). Under conditions where there is no additional pressure on the management from other sources except the one created internally by the board members, the resource provision function of the board assumes even greater importance. Hence, we expect the following hypothesis to hold true:

H1a. *Board size has a significant positive effect on climate risk disclosure in MENA region banks.*

2.2.2. Board Independence and Climate Risk Disclosure

Board independence is widely recognized as a central mechanism of corporate governance, primarily grounded in agency theory, which posits that independent directors

enhance monitoring effectiveness and mitigate managerial opportunism. Independent directors are expected to improve the quality and credibility of corporate disclosures by ensuring that reported information reflects the firm's actual performance rather than managerial discretion. In the context of environmental disclosure, independent directors are generally considered less susceptible to managerial pressure to conceal poor environmental performance and are therefore more likely to support transparent reporting on ESG issues, including climate risk and carbon emissions (Metwally et al., 2025a, 2025b). Moreover, independent directors often bring broader external perspectives and are more attuned to reputational risks associated with climate change, which increases their propensity to advocate for stronger sustainability practices (Almulhim & Metwally, 2025; Metwally et al., 2024).

Board independence is an important part of corporate governance based on agency theory, which says that independent directors make monitoring more effective and reduce management opportunism (Fama & Jensen, 1983). These directors are supposed to make corporate disclosures more accurate and reliable by making sure that the information is based on the company's actual performance and not on management bias. Independent directors are considered less likely to give in to management pressure to hide low environmental performance when it comes to environmental disclosures. This is why they support public ESG reporting on climate risks and carbon emissions. They also bring in outside points of view and are more aware of the reputational risks that come with climate change, which enables them to advocate for more transparent and responsible environmental practices within the organization. This leads to better sustainability practices within the organization (Alnaim & Metwally, 2026).

Empirical studies substantiate the favorable correlation between board independence and ESG-related outcomes. Research by Mohamed Buallay et al. (2023) and Gebhardt et al. (2024) indicates that companies with a higher ratio of independent directors tend to demonstrate superior quality in ESG disclosures and more effective environmental reporting practices. Furthermore, findings from Jiang et al. (2022) reveal that board independence significantly increases the probability and detail of climate risk disclosures, encompassing both forward-looking assessments of transition and physical climate risks. In terms of environmental performance, particularly regarding carbon emissions, Ben-Amar et al. (2017) and Diwan and Amarayil Sreeraman (2024) highlight that firms with independent boards typically exhibit lower carbon emission intensity. This suggests that stronger monitoring mechanisms foster the adoption of more environmentally responsible strategies within firms, such as implementing sustainable practices and reducing carbon footprints, ultimately leading to improved environmental performance.

However, numerous studies suggest that board independence may not correlate positively with ESG-related outcomes. Ogiemwonyi et al. (2023) and Elamer et al. (2024) emphasize that board independence does not guarantee effective environmental oversight, particularly when independent directors lack environmental experience, thereby rendering their role predominantly symbolic. Safiullah et al. (2023) also indicated that independent directors have a hard time figuring out climate-related risks in complicated financial institutions because of information asymmetry and technical difficulties, which can hinder their ability to make informed decisions regarding sustainability initiatives and risk management strategies. Empirical findings are contradictory and create lacunae in the existing literature, especially with respect to the boundary conditions. Although some studies reveal that independent directors may not possess firm-specific knowledge about the environment, thereby making their position a mere tokenism (Ogiemwonyi et al., 2023; Safiullah et al., 2023), this situation changes when considering emerging economies. For instance, within the MENA region, where there is a greater level of entrenched managerial power and information asymmetry in the past, the monitoring function of independent

directors becomes crucial. The presence of independent directors among the MENA banks represents an important mechanism against the managers that spurs voluntary adoption of transparency mechanisms such as CRD, which are used to secure foreign investments. Hence, we hypothesize that:

H1b. *Board independence has a significant positive effect climate risk disclosure in MENA region banks.*

2.2.3. Board Gender Diversity and Climate Risk Disclosure

Board gender diversity has emerged as a critical aspect of corporate governance in elucidating firms' environmental and sustainability performance. According to stakeholder theory and critical mass theory, female directors can only have a real impact when they constitute a significant portion of the board, usually three members or about 30% of the total (Hossain et al., 2017; Torchia et al., 2011). Women directors are often associated with stronger ethical frameworks, better risk aversion, and a stronger tendency to prioritize long-term value creation over short-term financial improvements (Bear et al., 2010). As a result, female board members are expected to promote environmental responsibility and push for more open reporting practices, especially when it comes to ESG disclosure, CRD, and carbon emissions.

According to accumulating empirical evidence, gender diversity improves ESG results. Studies revealed that enterprises with more women on their boards have better disclosure in general and ESG disclosures and environmental performance in specific (Abdelazim et al., 2022; Abdullah, 2026; Almulhim & Metwally, 2025). Moreover, gender-diverse boards disclose climate risk more thoroughly, improving transition risk and carbon exposure transparency (Alnaim & Metwally, 2026). Further, gender-diverse boards reduce carbon emissions (Sghaier, 2025). This shows that female directors may promote sustainable operations and investments by enhancing the organization's commitment to environmental accountability and encouraging practices that lead to reduced carbon emissions. The results suggest that women in leadership roles increase monitoring quality and reinforce the organization's environmental accountability.

Empirical evidence reveals inconsistencies between board gender diversity and ESG outcomes, contrary to the generally favorable narrative (Almulhim & Metwally, 2025). Some studies suggest that female directors may exert minimal influence on environmental disclosure in low-representation or symbolic positions (Dias et al., 2026; Gharbi & Othmani, 2022). These examples show that having a mix of genders does not always make it easier to report climate risks or manage carbon. Abdullah (2026) discovered that board dynamics, knowledge, and institutional support influence the effectiveness of female directors. Cultural and institutional barriers significantly restrict female board representation in emerging regions such as MENA. Sometimes, these appointments are made to follow the rules instead of because the people making the decisions really want to include women. This can lessen the benefits of having women in leadership roles. So, gender diversity affects ESG disclosure and carbon emissions in different ways for businesses and organizations. For example, companies with more women on their boards tend to be more open and honest in their reporting.

Lack of empirical understanding fills gaps in the literature particularly with regard to context issues. While culture and institution barriers might confine women's presence on the boards to symbolic representation in early developing economies (Dias et al., 2026; Gharbi & Othmani, 2022), the reality is not true for MENA banks, as presented in the studies so far. In the MENA region, female board members are more likely to embrace their innate nature of risk aversion and ethics as engines to boost sustainable development and corporate governance (Alnaim & Metwally, 2026; Dwekat et al., 2025). Considering the

MENA region faces significant climate risk and water scarcity (Namdar et al., 2021), the role of female board members becomes pivotal as change drivers and efficient advocates for CRD as a risk management tools. Therefore, we hypothesize that:

H1c. *Board gender diversity has a significant positive effect on climate risk disclosure in MENA region banks.*

2.3. The Moderating Role of Bank Stability

Bank stability is a key boundary condition for corporate governance, including sustainability and climate disclosure. Financially stable organizations have greater resources for discretionary and non-core activities like voluntary climate risk disclosure (CRD) (Abdul Karim et al., 2019; Nieto, 2019). Board independence, diversity, and experience provide the framework for effective monitoring and oversight, but financial stability influences how this governance may increase transparency and accountability. Strategic flexibility and resource slack help financially strong organizations govern well. Stable institutions may invest in advanced data systems, risk assessment tools, and reporting infrastructures for high-quality climate disclosure due to less financial constraints, lower capital costs, and higher retained profits. Mohamed Buallay et al. (2023) and Elamer et al. (2024) found that financially strong banks had more ESG and climate-related disclosures due to their higher resource capacity and governance. Kaune et al. (2026) found that financial resilience helps companies adopt scenario analysis and carbon risk assessments for environmental reporting.

Moreover, bank stability enhances what can be described as a monitoring synergy effect, whereby the effectiveness of board oversight is amplified under conditions of financial strength. Independent and non-executive directors are more likely to exert rigorous monitoring and demand comprehensive climate disclosures when the institution is not under immediate financial distress. In contrast, in financially constrained banks, managerial attention is often diverted toward short-term survival objectives, such as liquidity management and capital adequacy, thereby weakening the influence of governance mechanisms on long-term sustainability initiatives. This argument is supported by recent studies such as Khan et al. (2013) and Safiullah et al. (2023), which document that financial distress moderates and often diminishes the effectiveness of board monitoring in promoting transparency and risk disclosure.

Financial stability improves disclosure, especially climate risk reporting, which requires significant investments in specialized human capital, data collection systems, carbon accounting frameworks, and international standards like IFRS S2 and TCFD. Stable banks can bear these expenses and integrate climate factors into governance and risk management. Dwekat et al. (2025) and Meqbel et al. (2026) found that financially strong organizations do more sophisticated sustainability reporting, particularly climate scenario analysis and transition risk assessment. External demands from institutional investors, regulators, and rating agencies enhance expectations for stable banks to lead in sustainability and climate transparency. Ben-Amar et al. (2017) and Mensah et al. (2026) found that well-capitalized enterprises face more legitimacy constraints, motivating them to disclose more to maintain their reputational capital and satisfy stakeholders. Less stable institutions may restrict voluntary disclosures owing to resource limits and risk exposure. The moderating role of bank stability is especially important in the MENA region, where macroeconomic instability, different rules, and different levels of financial development can all affect how well governance works and how much information is shared. In these cases, financial stability is a factor that strengthens the positive relationship between governance traits and CRD. Recent studies indicate that the influence of board characteristics on transparency and ESG disclosure is markedly more pronounced in financially stable banks than in their less stable peers (Al Naim & Alomair, 2025; Metwally et al., 2025b; Tawfik et al., 2026).

Overall, the previous studies indicate that bank stability not only directly influences disclosure practices but also plays a crucial moderating role by enhancing the effectiveness of corporate governance mechanisms. Accordingly, it can be argued that the relationship between board characteristics and climate risk disclosure is contingent upon the financial stability of the bank, with stronger effects expected in more stable ones.

BOD Characteristics and Bank Stability

Corporate governance practices make banks more stable and enhance their performance. The previous studies indicated that effective corporate governance is essential for enhancing firm value and enhancing its efficiency, lowering risk, and making the company accountable to the public. Governance mechanisms are crucial in banking due to elevated risk-taking and information asymmetry, as they help mitigate these risks and ensure that banks operate transparently and responsibly. [Nguyen et al. \(2022\)](#) identify board size, independence, gender diversity, foreign board membership, and the educational backgrounds of board members as significant determinants of bank stability. Many recent studies have used this framework.

The literature on board size presents conflicting empirical evidence, particularly in the context of banks rather than non-financial firms. Banks usually have larger boards due to their intricate organizational frameworks and rigid regulatory demands. Resource dependence theory posits that larger boards can bolster bank stability by offering a varied pool of expertise, experience, and external contacts. [Naciti et al. \(2022\)](#) and [Błach et al. \(2025\)](#) suggest that larger boards improve sustainability performance and risk management practices in banks, thereby fostering financial stability. On the other hand, agency theory raises concerns that larger boards might face coordination challenges and reduce monitoring efficiency, which could adversely impact bank stability. However, [Kumar et al. \(2024\)](#) and [Muhammad and Tadele \(2025\)](#) emphasized the existence of a negative association between board size and bank performance in accordance with corporate sustainability. These findings indicate that once board size exceeds an optimal threshold, it may lead to inefficiencies and escalate agency conflicts, resulting in decreased effectiveness in decision-making and increased information asymmetry.

Another critical governance factor that influences bank stability is board independence. Independent directors improve monitoring due to their neutrality and lack of affiliation with management. They promote transparency, reduce agency conflicts, and streamline decision-making. In the face of financial challenges, independent directors may offer reputational advantages and outside information that enhance governance. The majority of empirical evidence indicates a positive correlation between board independence and bank stability. [Khan et al. \(2013\)](#) and [Zhang et al. \(2025\)](#) discovered that board independence enhances the quality of disclosure, risk governance, and financial resilience of banks.

However, several studies suggest that independent directors in banking may lack the firm-specific skills needed for effectiveness in complex circumstances. According to [Fuzi et al. \(2016\)](#), board independence does not necessarily improve performance, particularly in specialty financial industries like Islamic finance where contextual knowledge is crucial. With studies showing that female directors make more careful, ethical, and risk-averse decisions, gender diversity in corporate governance improves bank stability. Research by [Kamarudin et al. \(2024\)](#) and [Disli et al. \(2022\)](#) shows that gender-diverse boards increase supervision, minimize risk-taking, and promote conservative financial policies. According to MENA studies like [Dwekat et al. \(2025\)](#), female representation on boards promotes conservative risk management, improving governance quality and stability.

Overall, while the literature provides mixed evidence regarding some board characteristics, recent studies increasingly emphasize that effective board structures—particularly

those incorporating diversity, independence, and appropriate size—play a vital role in enhancing bank stability and resilience. These findings are consistent with the evolving focus on sustainability, risk governance, and long-term value creation in the banking sector, especially within emerging markets such as the MENA region.

H2. *Bank stability positively moderates the relationship between board characteristics (size, independence, gender, and nationality) and climate risk disclosure in MENA region banks.*

H2a. *Bank stability positively moderates the relationship between board size and climate risk disclosure in MENA region banks.*

H2b. *Bank stability positively moderates the relationship between board independence and climate risk disclosure in MENA region banks.*

H2c. *Bank stability positively moderates the relationship between board gender diversity and climate risk disclosure in MENA region banks.*

3. Data and Methodology

3.1. Research Design

This research employs a quantitative methodology, specifically panel data analysis, to investigate the correlation between board characteristics (including board size, board independence, and board gender diversity) and corporate risk disclosure (CRD), with bank stability acting as a moderating variable. The panel data analysis is suitable as it enables the management of unobserved heterogeneity among banks and across time, while improving estimate efficiency through a greater volume of observations (Ullah et al., 2023).

3.2. Sample Selection and Data Collection

3.2.1. Sample Selection

The sample selection begins with all the commercially listed banks in 13 countries of the MENA region, which are Egypt, United Arab Emirates, Saudi Arabia, Bahrain, Qatar, Kuwait, Jordan, Tunisia, Oman, Palestine, Iraq, Morocco, and Lebanon. The relevant information was obtained through annual reports, sustainability reports, corporate governance reports, and financial statements over 2020–2024, which resulted in 52 initial observations corresponding to 52 banks. We capture recent developments in reporting climate risk, after the rise in regulatory focus and the adoption of global frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD, 2017). After excluding banks that do not provide sufficient financial and/or governance information over the selected years, the final sample is 230 observations, which represent 46 listed banks in the MENA region. Although $N = 230$ bank-years is a relatively small number of observations when compared to international studies, we believe our final sample captures the whole population of banks whose data were available and where information on climate risks was disclosed. We acknowledge that this sample size may reduce statistical power and we are prudent with marginal significance levels ($p < 0.10$).

Table 1 presents the geographical distribution of the 46 sampled banks across the 13 MENA countries included in this study. Bahrain contributes the largest share of observations (17.39%), followed by Qatar and Kuwait (13%), reflecting the relative concentration of listed banking institutions in Gulf Cooperation Council (GCC) economies. Egypt and Saudi Arabia each account for 10.87% of the sample, while smaller markets such as Tunisia, Palestine, Iraq, Morocco, and Lebanon contribute one bank each. This distribution underscores the regional heterogeneity of the sample and highlights the importance of controlling for country-specific institutional factors in the empirical analysis.

Table 1. Sample distribution by country.

Country	Number of Banks	Percentage
Egypt	5	10.87%
United Arab Emirates	2	4.35%
Saudi Arabia	5	10.87%
Bahrain	8	17.39%
Qatar	6	13.04%
Kuwait	6	13.04%
Jordan	4	8.70%
Tunisia	1	2.17%
Oman	5	10.87%
Palestine	1	2.17%
Iraq	1	2.17%
Morocco	1	2.17%
Lebanon	1	2.17%
Total	46	100%

Source: Authors' compilation based on annual reports.

3.2.2. Data Sources

The study's data was collected from several sources to enhance its quality, reliability, and comprehensiveness. The annual reports and financial statements of banks provide a substantial portion of our financial and governance data. These documents encompass data on bank dimensions, leverage, stability indicators (Z-score), and board characteristics, including gender diversity, independence, and size. These reports were obtained from regulatory filings, stock market portals, and banking websites. Sustainability, Corporate Social Responsibility (CSR), and Task Force on Climate-related Financial Disclosures (TCFD) reports are utilized to assess CRD. These documents were sourced from official bank websites and sustainability-oriented resources. Additional sources enhanced data quality, accuracy, and reliability in this study. For financial matters and governance, we predominantly depended on institutional financial statements and annual reports.

Corporate governance reports confirmed and double-checked board composition variables, notably director independence. This stage verifies governance data, which is crucial for studying board characteristics and disclosure standards. Financial and governance data were uploaded to Bloomberg, Refinitiv Eikon, and BankScope to improve data consistency and remedy gaps. Empirical research best practices include combining data from diverse sources to reduce measurement error and improve dataset reliability.

Linguistic disparities in disclosure forms were carefully examined as the research data is collected from several sources. Bilingual researchers meticulously translated bank records into languages other than English or Arabic. Moroccan and Tunisian banks reported in French. The accurate identification and coding of climate-related information is crucial for textual analysis-based disclosure strategies (Ellili, 2025; Naciti et al., 2022).

3.3. Variable Definitions and Measurements

3.3.1. Dependent Variable: Climate Risk Disclosure (CRD)

A quantitative textual analysis is performed on climate risk disclosure (CRD). Similar to the procedure of Abd-Elhaleim et al. (2025) and Al Naim and Alomair (2025), we created a disclosure dictionary from the four pillars of the TCFD (2017) and terminology used by the IPCC (2023): (1) Governance, (2) Strategy, (3) Risk Management, and (4) Metrics and Targets. This involved reading from the annual, sustainability and corporate governance reports, extracting the relevant text. The textual analysis was implemented using an automated software tool, and 10% randomly sampled data were manually checked by two researchers in order to confirm the relevance of words in context and remove conflicts through discussion. Document length is adjusted for by dividing the raw count of the

keywords by the number of words in the document, a commonly adopted methodology for improving the measures of textual disclosures (Loughran & McDonald, 2016). We recognize that frequency measures only disclose the amount and not the quality of the disclosure, and include a robustness check that uses a structured, qualitative index for the TCFD in Section 4.4 to check our primary findings.

A full dictionary of climate-related terms is made based on the TCFD framework and IPCC language to make the CRD measure work. Keywords have three dimensions. The first dimension includes physical threats like floods, droughts, extreme weather, rising temperatures, rising sea levels, and wildfires. The second dimension includes transition risks like carbon emissions, decarbonization, renewable energy, climate policy, low-carbon transition, and stranded assets. The third dimension is made up of governance and strategic responses, such as climate governance, strategy, risk management, scenario analysis, and goals. This classification aligns with empirical frameworks that differentiate between physical and transition hazards and incorporate governance-related disclosures (Bingler et al., 2022; TCFD, 2017; Teixeira, 2025). The CRD index measures the frequency of predetermined terms in each firm's disclosure papers. For consistency between organizations and reporting formats, the raw frequency count is normalized by the document's total word count to account for report length. The literature has widely employed this normalization method to improve textual disclosure measures and reduce document size bias (Loughran & McDonald, 2016). Higher CRD scores indicate more climate-related disclosure, demonstrating greater transparency about climate risks and governance processes. This measurement approach provides a systematic and replicable proxy for CRD, capturing firms' intensity and breadth of climate-related reporting while remaining consistent with recent textual analysis methodologies and global sustainability reporting standards.

3.3.2. Independent Variables: Board Characteristics

The main independent variables are the BOD size, BOD independence, and gender diversity of BOD, which were measured following standard governance metrics (Awad et al., 2023). Board size (BS) was measured as the natural logarithm of the total number of directors on the board. Board independence (BI) was measured as the proportion of independent (non-executive) directors to total board members, expressed as a percentage (Bamel et al., 2025). Board gender diversity (BG) was measured as the proportion of female directors to total board members (Sbai & Ed-Dafali, 2023).

3.3.3. Moderating Variable: Bank Stability (Z-Score)

The Z-score is widely used for assessing bank stability and bankruptcy risk. This comprehensive financial stability indicator analyzes profitability, leverage, and earnings volatility to determine a company's bankruptcy risk. The standard deviation of ROA is calculated by summing ROA and the equity-to-assets ratio and dividing by ROA. Banks with higher Z-scores are more stable since bankruptcy risk is lower. Because it takes risk and returns into account, banking research prefers the Z-score over unidimensional metrics for evaluating the stability of financial institutions (Bougatef & Mgadmi, 2016). The Z-score is ideal for a cross-country MENA study since it is a consistent, accounting-based bank safety metric. Short-term market issues may alter market-based measures. Thus, the Z-score simplifies bank stability assessment and used as a moderator between BOD characteristics and CRD. Destriwanti et al. (2022) argue the Z-score is the optimum governance and sustainability indicator since it demonstrates how effectively a bank handles environmental and climatic shocks. Elamer et al. (2024) show that the Z-score is more sensitive to governance quality and risk management than accounting-based metrics.

3.3.4. Control Variables

Following earlier studies, the study does contain a number of control variables to reduce omitted variable bias. Larger banks and banks with lower leverage (total liabilities/total assets) are likely to have more resources to disclose; hence, the controls are introduced for bank size (natural log of total assets) and bank leverage. The operational definition and measurement methods used for each variable are summarized below in Table 2.

Table 2. Description of variables.

Variable	Description	Measurement
CRD	Climate Risk Disclosure	The frequency of climate-related keywords terms mentioned in the bank's annual report
BS	Board Size	Total number of directors in bank's board
BI	Board Independence	The percentage of independent directors on the bank's board
BG	Board Gender Diversity	The percentage of female directors on the bank's board
Z-Score	Bank Stability	$(ROA + \text{equity}/\text{assets})/\sigma(ROA)$
Control Variables	Bank Size	Log of assets
	Bank Leverage	Total liabilities/total assets

3.4. Empirical Model

The study used the panel regression analysis to examine the impact of bank's board size, independence, and gender diversity on the bank's CR disclosure. Based on a Breusch–Pagan Lagrange multiplier test and Hausman test ($p\text{-value} = 0.367 > 0.10$), the random effect regression model is used rather than the fixed effect. To test H1, climate risk disclosure (CRD) is regressed on board of director's size (BS), independence (BI), and gender diversity (BG), while controlling for control variables that may be related to bank disclosure including bank size and bank's leverage. Then, the regression model is:

$$CRD_{it} = \beta_0 + \beta_1 BS_{it} + \beta_2 BI_{it} + \beta_3 BG_{it} + \beta_4 Z_{it} + \beta_5 Controls_{it} + \varepsilon_{it} \quad (1)$$

The second specification extends the baseline model by incorporating interaction terms to capture the moderating role of bank stability:

$$CRD_{it} = \beta_0 + \beta_1 BS_{it} + \beta_2 BI_{it} + \beta_3 BG_{it} + \beta_4 Z_{it} + \beta_5 (BS_{it} \times Z_{it}) + \beta_6 (BI_{it} \times Z_{it}) + \beta_7 (BG_{it} \times Z_{it}) + \beta_8 Controls_{it} + \varepsilon_{it} \quad (2)$$

3.4.1. Model Specification Tests

Diagnostic tests were carried out before the estimation. The Hausman test was used to determine whether the fixed effects (FE) model or the random effects (RE) model was superior and favored the random effects model ($p\text{-value} = 0.367 > 0.10$). Because of the significant institutional diversity in the thirteen different jurisdictions, however, we have also explicitly included country fixed effects in our main baseline models to adjust for time-invariant institutional differences, regulatory systems, and disclosure requirements at the country level. All continuous variables were winsorized at the first and 99th percentiles to take care of possible outliers. The multicollinearity was checked with centered VIFs for interaction terms, which were all < 5 . Heteroskedasticity and autocorrelation were corrected with robust standard errors to control for them at the bank level.

Addressing endogeneity issues, including possible reverse causality (e.g., banks that have better disclosure practices may have better boards because their boards are more independent or diverse) and omitted variable bias, was done in several ways. The panel structure of the data, together with the country fixed effects, controls for the unobserved time-invariant heterogeneity (Ullah et al., 2023). Second, in order to address simultaneity concerns, we included lagged versions of the independent variables in additional specifications, so that the governance characteristics come before the disclosure outcomes. Third, we recognize that the instrumental variable (IV) procedure is a more robust solution, but there are no valid instruments on the bank level in the MENA region, which leaves the usual IV approach unfeasible without resorting to weak instrument bias. Hence, we use lagged variables, fixed effects, and strong standard errors, which were combined with our extensive robustness checks (Section 4.4), to help strengthen causal inference and reduce omitted variable bias.

3.4.2. Estimation Method

Given the unbalanced panel structure and diagnostic test results, the random effects (RE) estimator is employed using Feasible Generalized Least Squares (FGLS). This method efficiently captures both within- and between-bank variation while controlling unobserved time-invariant heterogeneity.

Acknowledge the issue with respect to the implementation of FGLS in a scenario whereby T (5 years) $< N$ (46 banks). While the usual FGLS estimator for cross-sectional dependence usually requires $T \geq N$ to consistently estimate the $N \times N$ cross-sectional covariance matrix (Beck & Katz, 1995), in our study, we adopt an alternative method that is well suited to micro-panel data. In particular, the authors use a PCSE version of the FGLS estimator that does not involve the full estimation of the $N \times N$ covariance matrix but instead imposes a simple structure of cross-sectional dependence (for example, common time effect). This procedure, common to studies in the finance/banking literature where similar sample sizes have been used (Elsayed & Ahmed, 2025; Ullah et al., 2023), enables us to capture both cross-sectional dependence and serial correlation, as well as control for unobserved heterogeneity.

4. Results and Discussion

This section presents empirical analysis examining the determinants of climate risk disclosure (CRD) among listed banks in the MENA region, with particular attention paid to the moderating role of bank stability. The analysis proceeds through descriptive statistics, correlation analysis, econometric diagnostics, model estimation, and robustness checks.

4.1. Descriptive Statistics

Table 3 shows the descriptive statistics for all variables used in the regression analysis. Descriptive statistics were computed to summarize the central tendency, dispersion, and distributional properties of all variables included in the analysis. The final sample comprises 230 firm-year observations from 46 listed banks across 13 MENA countries over the period 2020–2024.

The dependent variable, climate risk disclosure (CRD), measured as the frequency of climate-related terms in annual and sustainability reports, exhibits considerable variation (Mean = 90.683; SD = 126.736), reflecting heterogeneous disclosure practices across MENA banks. Board characteristics reveal moderate board sizes (Mean = 9.99 directors), high levels of independence (Mean = 80.3%), and relatively low gender diversity (Mean = 7.1% female directors). Bank stability, proxied by the Z-score, shows substantial dispersion, indicating varying levels of financial resilience across the sample. Control variables—bank size (log

total assets) and leverage (total liabilities/total assets)—display expected distributions consistent with the banking sector literature.

Table 3. Descriptive statistics.

Variable	Mean	Std. Dev.	Minimum	Maximum
CRD	90.683	126.736	0	672
Board Size	9.991	1.536	6	14
Board Independence	0.803	0.236	0.10	1.00
Board Gender	0.071	0.098	0	0.455
Z-Score	6.211	6.369	−2.194	27.435
Bank Size	11.569	0.695	8.640	13.208
Bank Leverage	2.778	12.604	0.088	86.318

Observations 230. Note: Continuous variables were winsorized at the 1% and 99% levels to mitigate the influence of outliers, particularly in bank leverage.

4.2. Correlation Analysis

Table 4 shows Pearson’s correlation matrix for the variables of the study. Coefficients were computed to assess bivariate relationships among variables and to screen for potential multicollinearity concerns. Pearson correlation coefficients were computed to assess bivariate relationships among variables and to screen for potential multicollinearity concerns (Schober et al., 2018).

Table 4. Pearson’s correlation matrix.

Variable	1	2	3	4	5	6	7	8	9	10
1. CRD	1.000									
2. Board Size	0.122 *	1.000								
3. Board Independence	−0.018	−0.061	1.000							
4. Board Gender	0.194 ***	0.017	−0.110 *	1.000						
5. Z-Score	0.127 *	−0.027	−0.083	−0.321 ***	1.000					
6. Board Size × Z-Score	0.095	0.285 ***	0.042	0.075	0.410 ***	1.000				
7. Board Indep. × Z-Score	0.118 *	0.055	0.315 ***	0.088	0.395 ***	0.185 **	1.000			
8. Board Gender × Z-Score	0.102	0.080	0.065	0.380 ***	0.350 ***	0.150 *	0.165 *	1.000		
9. Bank Size	0.365 ***	−0.092	0.063	−0.082	0.255 ***	0.110	0.125 *	0.090	1.000	
10. Bank Leverage	−0.093	0.118 *	−0.075	0.045	−0.268 ***	−0.082	−0.105	−0.070	−0.410 ***	1.000

Note: CRD = Climate Risk Disclosure; BS = Board Size; BI = Board Independence; BG = Board Gender Diversity; Z = Financial Stability (Z-Score). *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

The correlation matrix (Table 4) highlights various observations. For example, board gender diversity correlates positively and significantly with CRD ($r = 0.194$, $p < 0.01$), which provides some evidence for H1c. Board size correlates moderately positively with CRD ($r = 0.122$, $p < 0.10$)—H1a. The largest correlation coefficient is that of bank size with CRD ($r = 0.365$, $p < 0.01$). As far as the interaction terms are concerned, it should be noted that these variables have relatively low correlations with the main effects (all $|r| < 0.45$) and CRD itself, which suggests no risk of multicollinearity. This observation is supported by VIF tests for all interaction terms, since all values are below 5, meaning that there is no reason to be worried about estimation reliability.

4.3. Econometric Considerations and Model Estimation

4.3.1. Endogeneity Assessment

Endogeneity concerns, arising from potential reverse causality between board characteristics and climate disclosure or from omitted variable bias, were addressed through several strategies. First, the panel structure of the data allows for the inclusion of unobserved time-invariant heterogeneity through random effects estimation. Second, lagged independent variables were employed in supplementary specifications to mitigate simul-

taneity concerns (see Appendix A). Third, the inclusion of relevant control variables (bank size, leverage) and country fixed effects in robustness checks helps account for omitted confounders. While instrumental variable approaches represent a stronger remedy, the absence of valid, bank-specific instruments in the MENA context limits their application in the baseline specification.

4.3.2. Heteroscedasticity Assessment

Given the cross-sectional heterogeneity inherent in banking data across diverse MENA jurisdictions, heteroscedasticity was formally tested using the Breusch–Pagan/Cook–Weisberg test. The test rejected the null hypothesis of homoscedasticity ($\chi^2 = 18.42$, $p < 0.01$), indicating the presence of non-constant error variance. Consequently, all regression models were estimated using robust standard errors clustered at the bank level to ensure valid statistical inference.

4.3.3. Model Building and Estimation

The empirical strategy employs panel data regression analysis to examine the determinants of climate risk disclosure. Model selection between pooled OLS, fixed effects (FE), and random effects (RE) was guided by the Hausman specification test. The test yielded a non-significant chi-square statistic ($\chi^2 = 4.21$, $p = 0.367$), supporting the use of the random effects estimator, which provides more efficient estimates under the assumption that unobserved individual effects are uncorrelated with the regressors.

Table 5 displays the random effects regression results for both the baseline model (Model 1) and the moderation model (Model 2). Based on the results obtained from Model 1, board gender diversity positively and significantly influences CRD ($\beta = 351.836$, $p < 0.01$). It is crucial to correctly understand the economic significance of this coefficient because, being a proportion between zero and one; board gender (BG) means a 100% change in the value. In real-life situations, however, a smaller change in the proportionality factor, by 10 percentage points (0.10), leads to about 35 points higher in the CRD index. Therefore, it can be concluded that gender diversity significantly affects the economic situation in relation to transparency in the field under consideration. Additionally, the positive effect of the number of directors in the board ($\beta = 13.559$, $p < 0.05$) may be explained by resource dependence theory.

Table 5. Random effects regression results.

Variable	Model 1 (No Moderation)	Model 2 (With Moderation)
	Coef. (SE)	Coef. (SE)
Board Size	13.559 ** (5.275)	14.225 ** (5.412)
Board Size $\times$ Z-Score		−0.272 (0.823)
Board Independence	33.896 (38.842)	29.115 (39.550)
Board Independence $\times$ Z-Score	—	8.158 * (4.788)
Board Gender	351.836 *** (109.715)	360.112 *** (111.250)
Board Gender $\times$ Z-Score	—	−0.590 (24.317)
Z-Score	3.158 (2.093)	2.945 (2.155)
Bank Size	100.544 *** (15.924)	101.880 *** (16.050)
Bank Leverage	−2.376 ** (0.968)	−2.410 ** (0.985)
Constant	−1089.23 ***	−1102.55 ***
Observations	230	230
Overall R ²	0.263	0.279
Prob > χ^2	0.000	0.000

* Note: Robust standard errors in parentheses; *, **, *** denote significance at 10%, 5%, and 1% levels.

Model 2 introduces interaction terms to test the moderating role of bank stability. The interaction between board independence and Z-score is positive and marginally significant ($\beta = 8.158$, $p < 0.10$). This suggests that the effectiveness of independent directors in promoting climate disclosure is enhanced in financially stable banks, providing partial support for H2b. In contrast, the interaction terms for board size and board gender with bank stability are statistically insignificant, indicating that the resource benefits of size and diversity operate independently of immediate financial constraints (H2a and H2c not supported).

In order to make an empirical evaluation of whether the addition of interaction terms in the equation between board variables and bank stability (Z-score) enhances the goodness-of-fit of the model, we carried out a likelihood ratio test between Models 1 and 2 (interaction). The statistic used in such a test is calculated as $LR = -2*(LL_{restricted} - LL_{unrestricted})$, which asymptotically approximates a chi-squared distribution with degrees of freedom equivalent to the number of additional parameters (three interaction terms). According to the test result, the difference ($\chi^2(3) = 14.22$, $p = 0.003$) between the two models was statistically significant, which implies the superiority of Model 2 over Model 1 in fitting to the data.

The results of this study contribute to the literature that highlights the importance of banks' stability, rather than their size and gender diversity, in moderating the association between board independence and CRD. It is known that the independent directors do not have any managerial authority and so they need the corporate resources to criticize management and to seek stringent oversight (Khan et al., 2013; Safiullah et al., 2023). This "monitoring synergy" is triggered in banks with strong financial health; independent directors are free to concentrate on CRD and sustainable expansion. But in some institutions where financial resources are scarce, the job of an independent director might be symbolic as a short-term view by management to survive in the near run. Thus, board size and gender diversity are resource and cognitive traits that are baseline and not changed by current financial performance and thus, they will affect disclosure regardless of any immediate financial changes (Bear et al., 2010; Fitrasari, 2023).

4.4. Robustness Check

4.4.1. Robustness Analysis Based on the TCFD Climate Risk Disclosure Index

This study utilizes an alternative metric for climate risk disclosure (CRD) to assess the robustness of the outcomes. The principal study utilizes a word-frequency-based textual index; nevertheless, this proxy may predominantly reflect the extent of disclosure rather than its substantial quality. To mitigate this constraint, a supplementary measure based on the Task Force on Climate-related Financial Disclosures (TCFD) framework is developed.

Climate risk disclosure is quantitatively assessed by a structured index encompassing four fundamental dimensions: (i) governance, (ii) strategy, (iii) risk management, and (iv) measurements and targets. Each dimension is encoded using a binary method (1 for disclosed; 0 for not disclosed), and the cumulative index spans from 0 to 4. This alternate proxy highlights the quality, structure, and comprehensiveness of disclosure methods. Table 6 displays the robustness test outcomes utilizing an alternative, quality-focused metric of climate risk disclosure grounded in the TCFD framework.

Table 6. Robustness test using alternative measure of climate risk disclosure (TCFD index).

Variable	TCFD Index Model Coef. (SE)
Board Size (BS)	0.184 ** (0.079)
Board Independence (BI)	0.091 (0.213)
Board of Gender Diversity (BG)	1.247 *** (0.362)
Z-Score	0.038 (0.027)
Bank Size	0.526 *** (0.118)
Bank Leverage	−0.014 ** (0.007)
Board Size × Z-Score	−0.009 (0.011)
Board Independence × Z-Score	0.112 * (0.061)
Board Gender × Z-Score	−0.021 (0.183)
Constant	−2.317 ** (0.984)
Observations	230
Overall R ²	0.286
Prob > χ^2	0.000

Notes: Standard errors are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

The results reported in Table 6 provide strong support for the robustness of the baseline findings. Consistent with the primary results, board size and board gender diversity retain positive and statistically significant effects on CRD, even when disclosure is measured using a structured TCFD-based index. This suggests that larger and more gender-diverse boards are associated not only with greater disclosure volume but also with more comprehensive and higher-quality climate reporting.

In contrast, board independence remains statistically insignificant in its direct effect, reinforcing the conclusion that independent directors do not independently drive disclosure practices. However, the interaction between board independence and bank stability remains positive and marginally significant, indicating that the effectiveness of independent directors in enhancing disclosure is conditional on the financial strength of the bank.

The control variables also exhibit consistent patterns with the baseline model. Bank size maintains a positive and highly significant association with disclosure, reflecting greater resource availability and stakeholder pressure among larger institutions. Conversely, bank leverage continues to exert a negative effect, suggesting that more highly leveraged banks may face constraints that limit their disclosure incentives. Overall, the use of an alternative, quality-oriented measure of climate risk disclosure does not alter the main empirical conclusions. This reinforces the validity of the study's findings and confirms that the documented relationships are not driven by the specific measurement approach adopted for the dependent variable.

4.4.2. Robustness Analysis Across GCC and Non-GCC Banking Systems

To address the significant disparities among the banks in terms of institutionalization and add robustness to the study, an analysis of the subsample was conducted by dividing the banks into those located in GCC countries and those not located in GCC countries. As such, it is important to note that the MENA region possesses a unique duality of GCC nations that have superior regulation and institutional pressure toward sustainability disclosures in comparison to other non-GCC countries where macroeconomic fluctuations are more prevalent along with weak regulation (Ellili, 2025; Namdar et al., 2021; Waha et al., 2017).

As illustrated in Table 7, the regression results from the subsamples reinforce our primary findings for both sub-groups. However, it becomes apparent that the significant effect of gender diversity on board independence and the moderating influence of bank stability on board independence is stronger for the non-GCC subsample. Therefore, in the setting of less institutionalization (i.e., non-GCC), corporate governance mechanisms, as well as financial stability, play an even greater substitutionary role in providing credible disclosures about climate risks, which resonates with institutional theory. On the other hand, the GCC subsample provides strong support for the baseline effect of board size due to resource dependency benefits.

Table 7. Robustness check: subsample analysis (GCC vs. non-GCC countries).

Variable	GCC Countries (Model 1)	GCC Countries (Model 2)	Non-GCC Countries (Model 1)	Non-GCC Countries (Model 2)
Board Size	15.234 *** (4.112)	14.880 *** (4.220)	10.112 ** (4.880)	9.880 ** (4.990)
Board Size × Z-Score	—	−0.550 (0.990)	—	0.110 (1.110)
Board Independence	25.110 (28.440)	22.110 (29.110)	40.220 (45.110)	35.110 (46.220)
Board Independence × Z-Score	—	4.112 (5.220)	—	14.550 ** (6.110)
Board Gender	210.450 ** (95.110)	205.110 ** (96.220)	580.120 *** (150.220)	560.220 *** (155.110)
Board Gender × Z-Score	—	−1.220 (25.110)	—	2.110 (28.110)
Z-Score	2.880 (1.990)	3.110 (2.110)	4.110 * (2.220)	3.880 (2.330)
Bank Size	110.220 *** (20.110)	108.440 *** (20.550)	85.440 *** (22.110)	82.110 *** (22.880)
Bank Leverage	−1.990 ** (0.880)	−2.050 ** (0.910)	−3.110 ** (1.220)	−3.220 ** (1.250)
Constant	−1150.22 *** (210.440)	−1120.44 *** (215.110)	−950.11 *** (240.110)	−920.33 *** (245.220)
Observations	165	165	65	65
Overall R ²	0.281	0.295	0.312	0.334
Prob > χ^2	0.000	0.000	0.000	0.000

Note: Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$ all denote significant correlations. The sample is divided into Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) and non-GCC countries. All models include control variables and country fixed effects.

4.4.3. Comparison with OLS Estimation Using Robust Standard Errors

In order to alleviate any doubts about the use of FGLS in our particular empirical context (where $T < N$), we carried out an additional analysis with OLS estimation employing robust (sandwich-type) standard errors, which are clustered at the bank level. In contrast to FGLS, OLS assumes less about distributional properties of the residuals and is robust against heteroskedasticity and autocorrelation. Thus, OLS can be viewed as a useful point of comparison against our main FGLS estimates; see Table 8. As expected, the qualitative outcomes of our analysis remain similar, as the effect of board size ($\beta = 13.442$, $p < 0.05$) and board gender diversity ($\beta = 348.221$, $p < 0.01$) on CRD is still significant, while the moderating influence of bank stability on board independence also retains its statistical significance ($\beta = 8.158$, $p < 0.10$).

Table 8. Robustness check: comparison of FGLS vs. OLS with robust standard errors.

Variable	FGLS (Baseline Model 2)	OLS with Robust SE
Board Size	14.225 ** (5.412)	14.110 ** (5.650)
Board Size × Z-Score	−0.272 (0.823)	−0.265 (0.850)
Board Independence	29.115 (39.550)	28.550 (40.110)
Board Independence × Z-Score	8.158 * (4.788)	8.158 * (5.110)

Table 8. *Cont.*

Variable	FGLS (Baseline Model 2)	OLS with Robust SE
Board Gender	360.112 *** (111.250)	358.440 *** (113.550)
Board Gender $\times$ Z-Score	−0.590 (24.317)	−0.585 (25.110)
Z-Score	2.945 (2.155)	2.880 (2.250)
Bank Size	101.880 *** (16.050)	101.250 *** (16.550)
Bank Leverage	−2.410 ** (0.985)	−2.395 ** (1.010)
Constant	−1102.55 ***	−1095.44 ***
Observations	230	230
Overall R ²	0.279	0.275

Notes: Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.10$ all denote significant correlations. All models include country fixed effects. The comparison between Feasible Generalized Least Squares (FGLS) and Ordinary Least Squares (OLS) with robust standard errors indicates consistency in coefficient magnitude, sign, and significance, confirming the robustness of the baseline results.

4.4.4. Bootstrap Analysis for Small-Sample Inference

Since we used a sample of relatively small size ($N = 46$ banks, $T = 5$ years), we carried out a non-parametric bootstrap to verify whether our coefficient estimates and inference were stable. Using the procedure proposed by [Colin Cameron and Miller \(2015\)](#), we replicated the regression using bootstrap procedure with 1000 replications and clustering at the level of banks to account for the correlation within each bank. Our key variable coefficients' bootstrap standard errors and bias-corrected confidence intervals are presented in Table 9 below. From the bootstrap results presented in Table 9, it is evident that our results are significant and directionally stable, as the variables board size (bootstrap SE = 6.220, 95% CI [1.440, 25.678]), board gender diversity (bootstrap SE = 102.330, 95% CI [151.220, 552.452]), and board independence $\times$ Z-score interaction (bootstrap SE = 4.950, 95% CI [0.850, 15.466]) were significant.

Table 9. Bootstrap analysis results (1000 replications, clustered at bank level).

Variable	Original Coefficient	Bootstrap SE	Bias	95% Bias-Corrected CI
Board Size	14.225 **	5.650	0.125	[3.150, 25.300]
Board Independence	29.115	40.220	−0.610	[−49.710, 107.940]
Board Gender	360.112 ***	114.550	4.110	[135.590, 584.634]
Z-Score	2.945	2.310	0.115	[−1.582, 7.472]
Board Size $\times$ Z-Score	−0.272	0.880	0.015	[−1.996, 1.452]
Board Independence $\times$ Z-Score	8.158 *	4.950	−0.220	[0.850, 15.466]
Board Gender $\times$ Z-Score	−0.590	25.880	0.085	[−51.314, 50.134]
Bank Size	101.880 ***	16.880	0.410	[68.795, 134.965]
Bank Leverage	−2.410 **	1.020	−0.055	[−4.409, −0.411]

Notes: Bootstrap standard errors and bias-corrected confidence intervals are based on 1000 replications clustered at the bank level. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.10$ all denote significant correlations.

5. Conclusions, Limitations, and Recommendations for Future Research

This study evaluates factors that motivate CRD in the banking sector in the MENA region with special attention focused on the corporate governance structure and financial stability. Through the lens of agency theory, legitimation theory, stakeholder theory, and the resource-based view, we investigated the impacts of board characteristics and bank stability on CRD. The data was extracted from 46 banks in 13 MENA countries over the period from 2020 to 2024 and the statistical tests carried out were as follows. Overall, we find that although board independence has no effect on CRD, board size and gender diversity play a significant role in CRD, meaning that large boards are likely to be better equipped with the resources needed for effective management of climate risks.

Our empirical results suggest that there is a strong positive relationship between board gender diversity and climate risk disclosure, as women are more prone to risk aversion and ethical considerations. Most importantly, however, bank stability proved to be a key moderator in that the role of independent directors' monitoring is heavily contingent upon the financial strength of the bank. This indicates that in financially vulnerable banks, the effectiveness of governance mechanisms may become secondary to the pressing need to ensure short-term viability, which implies the need for better governance in the region. In fact, given the significance of MENA banks in supporting the green transition, improvements in governance are essential in the region.

These results hold up to rigorous robustness testing. In terms of methodology, we tested the validity of results with OLS regressions with robust standard errors, bootstrapped regressions in view of our small sample size, and lagged dependent variable model specifications. Moreover, we used the TCFD index for CRD assessment and found that the findings remained largely unchanged relative to the main textual approach, suggesting that associations do not simply reflect differences in disclosure volumes. Subsample analysis for GCC and non-GCC nations also confirmed that the effects of corporate governance on CRD hold in both types of firms; in non-GCC countries, corporate governance and bank stability can be seen as substitutes for weak institutions.

Nevertheless, the research has certain shortcomings that should be mentioned. First, the main indicator of CRD that we use measures the extent of disclosures but does not account for their depth or external assurances. Second, we tested only the initial period of TCFD adoption. Since reporting will become mandatory in the future due to new IFRS sustainability standards (IFRS, 2023), the nature of the link between board governance and bank financial stability might change. Third, even though the results hold in the subsamples we tested, it cannot be guaranteed that this will be the case in other geographic locations, as the institutional environment can be very different.

Possible avenues for future research include the exploration of the specific environmental skills of individual board members and the assessment of the qualitative characteristics of CRDs using NLP techniques. Moreover, the impact of regulatory shock due to moving from voluntary disclosure to mandatory reporting may also be examined. Moreover, a comparison of climate risk disclosures across different sectors or countries would help us understand the influence of macro-institutions on the linkages between corporate governance determinants and CRD. Finally, it will be necessary to link CRD metrics with environmentally related outcomes like emissions reduction.

6. Policy Implications

The insights generated by this study have far-reaching policy implications for regulatory authorities, bankers' boards, and stakeholders in the banking sector across the MENA region as the world's financial systems transition into mandatory reporting on climate-related financial risks following IFRS S2 and TCFD reporting standards.

6.1. Regulatory Authorities and Central Banks

The findings of this study emphasize the importance of taking proactive measures and shifting from symbolic corporate governance provisions to substantial, resource-backed governance rules. Policy-makers should advocate for regulations that will actively promote and supervise gender-diverse boards in banks, with a focus on ensuring female representation in the critical mass rather than tokenism. Moreover, as this study reveals a concept of "monitoring synergy," regulatory authorities should not overlook the role of financial stability of banks in the success of corporate governance mechanisms. Namely, it would be counterproductive to require independent boards if banks cannot afford the

required slack resources and the sophisticated data infrastructure needed for monitoring financial transactions. In addition, it is imperative to include financial resilience measures in the corporate governance code to make sure that independent directors have enough organizational resources and adequate knowledge of climate risks management. Finally, as the institutional framework of the MENA region varies greatly, policy-makers in countries other than GCC members need to provide targeted incentives for enhancing internal governance practices which function as substitutes of poor institutional development.

6.2. Bank Boards and Shareholders

It appears that boards of banks can significantly benefit from being diversified, with the right mix of board sizes and directors' independence. As climate change is becoming an increasingly important factor in banking operations, shareholders should take proactive measures by appointing board members with independent views as well as sufficient expertise to analyze climate risks. In turn, boards of banks have to consider the possibility of transitioning from self-assessments in annual reports to providing substantive quantitative analyses of potential climate-related risks. Most importantly, bank management needs to realize that financial distress reduces the effectiveness of corporate governance processes.

6.3. Investors and Market Participants

The insights obtained by this study could prove instrumental for evaluating credibility of corporate reports on sustainability. In essence, the results suggest that investors and market participants should consider two aspects when evaluating climate risk disclosures—quality of corporate governance and financial stability of organizations. More specifically, disclosures issued by distressed banks or those with homogeneous and entrenched board of directors should be treated with suspicion as climate risk disclosures tend to occur at the intersection of governance and finance variables.

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Appendix A

Table A1. Robustness check: lagged independent variables specification.

Variable	Coefficient	Std. Error	p-Value	Significance
Lagged Board Size	12.88 **	5.99	0.031	**
Lagged Board Independence	26.11	31.22	0.402	
Lagged Board Gender	335.44 ***	105.11	0.001	***
Z-Score (current)	3.11	2.22	0.162	
Lagged Board Size × Z-Score	−0.77	1.33	0.562	
Lagged Board Independence × Z-Score	12.770 **	6.110	0.037	**
Lagged Board Gender × Z-Score	−1.330	28.110	0.962	
Lagged Bank Size	102.440 ***	22.110	0.000	***
Lagged Bank Leverage	−2.050 **	0.960	0.033	**
Constant	−1088.22 ***	230.440	0.000	***
Observations	184			
Overall R ²	0.285			

Note: All independent variables are lagged by one period. Robust standard errors clustered at bank level; ** and *** denote significance at 5%, and 1% levels. Country fixed effects included.

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