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Women Leaders, Cybersecurity Disclosure & ESG Performance: Are Women More Cybersecurity-Aware?

Zainuddin[1], Bambang Tjahjadi[1]
Department of Accounting, Faculty of Economics and Business, Universitas Airlangga, Surabaya, East Java, Indonesia[1.1]
Kampus B Jl. Airlangga No. 4-6 Surabaya 60286 Indonesia
Coresponding Email: bambang.tjahjadi@feb.unair.ac.id
Orcid ID: https://orcid.org/0000-0002-9781-729X

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ABSTRACT

This study investigates the effect of women leaders on ESG performance through the mediating role of cybersecurity disclosure. Employing a sample of 46 banks across ASEAN countries (Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam) over the period 2017–2022, the study yields 242 firm-year observations. Cybersecurity disclosure was measured using content analysis, while data were analyzed using panel regression with robustness and additional tests to ensure consistency. The findings reveal that both women on boards and female chairpersons have a significant positive impact on cybersecurity disclosure, which in turn significantly enhances ESG performance. Furthermore, cybersecurity disclosure fully mediates the relationship between women leaders and ESG performance. This research confirms the relevance of Resource Dependency Theory and contributes by proposing a structured cybersecurity disclosure keyword framework for future studies. Practically, the findings urge stakeholders to increase the representation of women in both number and strategic leadership roles, and to integrate cyber risk into ESG metrics. The study also contributes to the achievement of SDG 5, SDG 8, and SDG 12.

Keywords: Women leaders, cybersecurity disclosure, ESG, technofeminism.

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INTRODUCTION

The rapid pace of digital transformation has introduced new challenges across the business landscape. One of the most serious is the growing threat of cyberattacks, which undermine organizational stability and public trust. The (Federal Bureau of Investigation, 2022) recorded more than 800,000 cybercrime incidents in 2022, affecting over 422 million individuals. (The World Economic Forum, 2024) projects global losses from cyberattacks to reach USD 23.82 trillion by 2027. These alarming figures highlight the urgent need for robust digital governance as an integral part of corporate sustainability strategies.

In the ASEAN region, the banking sector is among the most vulnerable to cyber threats, given the high volume of financial data handled and the demand for system integrity. ASEAN's digital economy is expected to reach USD 100 billion by 2023 (Center for Strategic and International Studies, 2024), yet countries such as Singapore, Indonesia, Thailand, and Vietnam remain key cyberattack targets. The National Cyber Security Index (NCSI) reveals that digital preparedness in these countries remains inadequate (Databoks, 2023). At the same time, the global emphasis on Environmental, Social, and Governance (ESG) performance urges firms to go beyond profitability and focus on sustainability and transparency (Azmi et al., 2021; Chiaramonte et al., 2022; Galletta et al., 2023).

In this context, cybersecurity is a crucial pillar of ESG particularly within the governance and social dimensions as it involves stakeholder data protection and the integrity of organizational systems (Alkaraan et al., 2022; Asif et al., 2023; Saxena et al., 2023). However, the role of leadership, especially women in strategic positions, remains underexplored in managing cybersecurity within ESG frameworks. The literature shows that female board members foster more ethical, inclusive, and transparent decision-making processes (Arnaboldi et al., 2021; Hu et al., 2022; Menicucci & Paolucci, 2022b; Moscatelli et al., 2020; Pullen & Vachhani, 2021). The technofeminism approach further supports this by asserting that women offer unique intuitive and humanistic responses to complex digital risks (DeVoss, 2019).

While some studies confirm that women's leadership has a direct positive impact on ESG performance (Birindelli et al., 2018; Hu et al., 2022), others report weak or statistically insignificant relationships (Martín & Herrero, 2018). These inconsistencies imply that the influence of female leadership on ESG may not operate directly, but rather through intervening mechanisms such as cybersecurity disclosure. This disclosure practice reflects transparency, accountability, and responsiveness to risk—qualities often advocated by female leaders (Asif et al., 2023; Pullen & Vachhani, 2021). Therefore, cybersecurity disclosure is positioned as a mediating variable linking women's leadership to ESG performance.

Drawing on Resource Dependency Theory (RDT) and technofeminism, this study proposes that women leaders serve as strategic organizational resources to enhance governance and sustainability. However, empirical research integrating all three variables remains limited, particularly in the ASEAN context, where most studies are single-country and lack a comprehensive framework. This study offers several key contributions. First, it is among the first to examine the relationship between women's leadership, cybersecurity disclosure, and ESG performance across ASEAN countries. Second, it explicitly positions cybersecurity disclosure as a mediating variable, which remains underexplored in the literature. Third, it combines RDT and technofeminism to explain how women leaders play a strategic role in promoting sustainable governance.

The remainder of this article is structured as follows: Section 2 presents the literature review; Section 3 outlines the data and methodology; Section 4 discusses the results; Section 5 concludes; and Section 6 provides policy recommendations.

LITERATURE REVIEW

Resource Dependency Theory (RDT) and Board Gender Diversity

This study is grounded in Resource Dependency Theory (RDT), as originally articulated by (Pfeffer & Salancik, 1978), which posits that organizations are not self-sufficient but depend on critical resources from their external environments to survive and thrive. Within this framework, the board of directors serves as a strategic conduit that links the firm with external sources of legitimacy, expertise, and information (Majid et al., 2023). A significant resource within this dynamic is board gender diversity, which is increasingly viewed not only as a symbol of inclusivity but as a strategic asset. Empirical studies have shown that gender-diverse boards enhance decision quality by bringing diverse cognitive perspectives, lived experiences, and ethical reasoning into corporate deliberations (Oware et al., 2023; Saggar et al., 2022; Tyrowicz et al., 2020). Hillman and Thomas (as cited in Saggar et al. 2022) further argue that diverse boards expand a firm's access to analytical capabilities, innovative thinking, and stakeholder legitimacy elements crucial for navigating complex and volatile environments

Technofeminism and Women's Leadership in Risk Governance

Complementing RDT, the technofeminist approach provides a nuanced understanding of how women in leadership contribute uniquely to managing technological complexity. Women are often associated with more intuitive, cautious, and ethically-oriented decision-making, particularly in contexts involving uncertainty and systemic risk, such as cybersecurity (Anwar et al., 2017; Mazumder & Hossain, 2023). In this regard, female board members and executives are seen as organizational resources who can strengthen governance quality, particularly by promoting transparency and accountability in risk disclosure practices.

Cybersecurity Disclosure as a Governance Instrument

Cybersecurity disclosure (CSD) has emerged as a critical governance tool, particularly in the digital era where cyber threats represent a material risk to financial performance and corporate reputation. CSD refers to the structured communication of cyber risk exposure, preparedness, and response strategies, often within sustainability or annual reports (Gao et al., 2020). It has been increasingly recognized as an indicator of a firm's risk governance capacity (Héroux & Fortin, 2022; Refsdal et al., 2015). Although cybersecurity reporting has become integrated into board-level disclosure standards in countries like the United States (Pucheta-Martínez et al., 2016), it remains largely voluntary in many regions and presents ethical dilemmas—such as selective disclosure or underreporting due to reputational concerns (Bongiovanni et al., 2022). Nonetheless, effective CSD plays a crucial role in promoting transparency, meeting stakeholder expectations, and protecting long-term firm value (Kamiya et al., 2021)

Despite the growing attention to gender diversity and ESG performance, research explicitly examining cybersecurity disclosure as a mediating mechanism remains limited, especially in the context of ASEAN's banking sector, thus underscoring the relevance and novelty of this study.

Hypotheses Development

Women leaders dan Cyber Security Disclosure

In line with Resource Dependency Theory (RDT), diversity in corporate leadership is recognized as a strategic resource that enhances a firm's ability to navigate uncertainty, manage external pressures, and access critical information. Gender-diverse boards are particularly effective in reducing information asymmetry and resolving conflicts of interest, as they tend to approach governance with a broader set of perspectives and ethical considerations (Islam et al., 2022; Majid et al., 2023). Empirical evidence has shown that inclusive boards especially those with multiple women—are

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more proactive and balanced in addressing complex governance issues, including digital risk management (Saggar et al., 2022). Cybersecurity disclosure (CSD), while still largely voluntary, requires strong internal drivers to be implemented consistently and credibly. Studies have demonstrated that women directors contribute significantly to the quality and transparency of cybersecurity disclosures (Hossain et al., 2020; Radu & Smaili, 2022; Smaili et al., 2023). Women are often credited with analytical rigor, ethical sensibility, and heightened risk awareness traits that are especially valuable in overseeing strategic disclosures in high-stakes environments like cybersecurity (Mazumder & Hossain, 2023).

Furthermore, women in leadership tend to adopt cautious and detail-oriented approaches when communicating sensitive risks to stakeholders (Al Fadli et al., 2019; Georg-Schaffner & Prinz, 2022; Zhang et al., 2013). Evidence suggests that boards with at least three women are more likely to engage in meaningful disclosure practices, including those related to digital security (Anwar et al., 2017). The impact is even more pronounced when women hold the chairperson role, where they exert greater influence over the strategic agenda. Female chairs often shape organizational culture toward greater openness, accountability, and responsiveness to societal issues, including cybersecurity (Ellwood & Garcia-Lacalle, 2018; Francis et al., 2024; Héroux & Fortin, 2022; Luh & Kusi, 2023). From a technofeminist lens, women in leadership are seen as uniquely positioned to recognize the ethical dimensions of technology, due to both their lived experiences and critical reflexivity in navigating digital risks (Clinnin & Manthey, 2019; De Hertogh et al., 2019). Based on the theoretical and empirical rationale, the following hypotheses are proposed:

H1a: The proportion of women on corporate boards has a significant positive effect on cybersecurity disclosure.

H1b: The presence of a female chairperson has a significant positive effect on cybersecurity disclosure.

Cybersecurity Disclosure and ESG Performance

Cybersecurity disclosure (CSD) refers to the firm's communication regarding its digital security frameworks, risk mitigation efforts, and incident responses. This practice is increasingly viewed as a core aspect of environmental, social, and governance (ESG) performance, particularly under the governance and social pillars (Agnese et al., 2024; Kurnia & Ardianto, 2024). In an era of rapid digital transformation, especially within the banking sector, stakeholders now expect institutions to demonstrate not only financial resilience but also digital responsibility (Gurol & Lagasio, 2023; Wu et al., 2023). Effective CSD strengthens stakeholder confidence, enhances public trust, and fosters a reputation for responsible governance (Almaqtari, 2024; Dicuonzo et al., 2024). In financial services, cyber risk disclosures also promote better network governance and operational resilience (Al-Sartawi, 2020; Refsdal et al., 2015). A report by (KPMG, 2023) concludes that integrating cybersecurity within ESG frameworks enhances a firm's market credibility and sustainability profile. Therefore, this study proposes the following hypothesis:

H2: Cybersecurity disclosure has a significant positive effect on ESG performance.

Mediating Role of Cybersecurity Disclosure

While prior research has shown that women's leadership can directly contribute to ESG outcomes, emerging studies suggest that this relationship may be more nuanced. Specifically, female directors and chairs are associated with higher levels of cybersecurity transparency, which in turn facilitates stronger ESG performance (Menicucci & Paolucci, 2022a; Wu et al., 2023). In this context, cybersecurity disclosure may serve as the mechanism through which female leadership translates into broader sustainability outcomes. According to RDT, women in strategic roles contribute not only leadership diversity but also access to novel resources, industry insights, and stakeholder legitimacy (Hillman & Thomas, 2003; Mohd-Said et al., 2018). Meanwhile, technofeminist theory emphasizes the lived experiences of women particularly their disproportionate exposure to online threats which may shape their risk consciousness and foster more transparent disclosure practices (DeVoss, 2019; Saggar et al., 2022). This mediating effect is especially relevant in the presence of a female chairperson, who has the authority to institutionalize governance practices and embed cybersecurity into strategic planning. Women leaders are also known for their ethical decision-making and commitment to social responsibility factors that enhance the credibility of both CSD and ESG reporting (Kamiya et al., 2021; Post & Byron, 2015). Accordingly, the following mediation hypotheses are proposed:

H3a: Cybersecurity disclosure significantly mediates the relationship between women on boards and ESG performance.

H3b: Cybersecurity disclosure significantly mediates the relationship between the presence of a female chairperson and ESG performance.

RESEARCH METHOD

Data

This study utilizes panel data from publicly listed banking institutions across six ASEAN countries: Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. From a total of 122 listed banks in these countries, only 46 met the inclusion criteria based on the availability of key information, particularly regarding cybersecurity disclosure (CSD) and ESG performance. The study covers a six-year period from 2017 to 2022, resulting in a total of 242 firm-year observations. Data on cybersecurity disclosure were collected through content analysis of annual and sustainability reports available on the official websites of each bank. Meanwhile, ESG scores and financial data were obtained from the Bloomberg Terminal, ensuring the use of standardized and widely recognized performance indicators.

Variable Measurement

This study investigates the influence of women's leadership on ESG performance, with cybersecurity disclosure (CSD) serving as a mediating variable. The dependent variable, ESG performance, is measured using ESG scores obtained from the Bloomberg Terminal. These scores are based on a matrix-style assessment of environmental, social, and governance criteria, and reflect the extent to which firms incorporate sustainability considerations into their operations. Bloomberg's ESG scoring methodology has been widely adopted in prior empirical studies, such as (Atif et al., 2022), (Lee, 2024), and (Liu et al., 2023), due to its reliability, comparability, and comprehensive coverage across firms and industries.

Women's leadership, the independent construct, is operationalized through two complementary indicators that capture both representation and influence within corporate boards. The first is the proportion of female board members to the total number of directors, which reflects structural diversity (Nadia & Hanafi, 2022). The second is a binary indicator denoting whether the chairperson of the board is female, representing leadership at the highest level of strategic authority (Salvador et al., 2023). These measures are grounded in Resource Dependency Theory and prior governance research, where gender-diverse boards are associated with broader access to legitimacy, cognitive perspectives, and stakeholder engagement (Saggar et al., 2022).

The mediating variable, cybersecurity disclosure (CSD), refers to the extent to which firms disclose information on cybersecurity-related policies, strategies, risks, and incidents in their publicly available reports. CSD is measured using a manual content analysis of annual and sustainability reports. Two core metrics are employed: (1) the number of keywords related to cybersecurity, and (2) the number of paragraphs explicitly discussing cybersecurity. These metrics follow established disclosure research practices

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(Radu & Smaili, 2022; Smaili et al., 2023), and the keyword list includes terms such as "cyber," "cybersecurity," "data breach," "ransomware," "malware," "IT," and "system security," among others (Mazumder & Hossain, 2023). To enhance replicability and accuracy, a Python-based script was developed to conduct keyword searches across documents, enabling efficient and consistent extraction of disclosure content across firms and years.

To control for potential confounding influences, this study incorporates firm-level and macro-level control variables. Firm size is included and measured as the natural logarithm of total assets, based on the rationale that larger firms are generally subject to greater public scrutiny and more stringent regulatory requirements (Radu & Smaili, 2022). Additionally, fixed effects for year and country are introduced to account for temporal dynamics and institutional differences across ASEAN member states. This approach aligns with best practices in panel data research and enhances the validity and generalizability of the empirical findings (Azmi et al., 2021; Khlifi et al., 2024).

Model Analysis

To examine the mediating role of cybersecurity disclosure (CSD) in the relationship between women's leadership and ESG performance, this study adopts the causal-step approach proposed by (Baron & Kenny, 1986). Mediation is assessed through a series of regression models estimated using STATA, allowing for the simultaneous testing of direct and indirect effects. The mediation is considered statistically supported if three conditions are met: (1) women leaders significantly influence CSD; (2) CSD significantly predicts ESG performance; and (3) the direct effect of women leaders on ESG performance weakens when CSD is introduced into the model. The models are estimated with robust standard errors and include year and country fixed effects to control for unobserved heterogeneity over time and across countries. This enhances the validity and robustness of the estimations in a multi-country, multi-period setting. The analytical framework is structured into three regression models as follows:

Model 1

$$\text{Coverage paragraph}_{it} = \beta 0 + \beta_1 \text{Women on boards}_{it} + \beta_2 \text{Female chairperson}_{it} + \beta_3 \text{Size}_{it} + \sum Year_{it} + \sum Country_{it} + \varepsilon_{it}$$

Model 2

$$\text{ESG Score}_{it} = \beta 0 + \beta_1 \text{ Coverage paragraph}_{it} + \beta_2 \text{Size}_{it} + \sum Year_{it} + \sum Country_{it} + \varepsilon_{it}$$

Model 3

$$\text{ESG Score}_{it} = \beta 0 + \beta_1 \text{Women on boards}_{it} + \beta_2 \text{Female chairperson}_{it} + \beta_3 \text{ Coverage paragraph}_{it} + \beta_4 \text{Size}_{it} + \sum Year_{it} + \sum Country_{it} + \varepsilon_{it}$$

Where:
Coverage paragraph = extent of cybersecurity disclosure
Women on boards = proportion of female directors
Female chairperson = dummy variable for female board chair
Size = firm size measured as log of total assets
Year, *Country* = fixed effects
ε = error term

RESULTS

Descriptive statistics for the study variables are presented in Table 1. The average ESG score is 43.13 (SD = 9.63), with a range from 16.08 to 66.44, indicating considerable variation in sustainability performance across firms. The mean value for cybersecurity disclosure is low, with coverage word averaging 0.001 (SD = 0.001) and coverage paragraph at 0.227 (SD = 0.13), suggesting limited attention to cybersecurity in public disclosures. Regarding gender diversity, the average proportion of women on boards is 0.195 (SD = 0.122), while only 9.1% of firms have a female chairperson (SD = 0.289), highlighting underrepresentation in leadership roles. The mean value for firm size, measured as the natural logarithm of total assets, is 16.095 (SD = 2.062), with values ranging from 10.734 to 20.131.

Table 1: Descriptive Statistics of Main Variables

Variable	Mean	Std. Dev.	Min	Max
ESG Score	43.13	9.63	16.08	66.44
Coverage word	.001	.001	0	.004
Coverage paragraph	.227	.13	0	.837
Women on boards	.195	.122	0	.571
Female chairperson	.091	.289	0	1
Size	16.095	2.062	10.734	20.131

Table 2 shows notable variation in ESG performance, cybersecurity disclosure, and women's leadership across the ASEAN banking sector. Singapore records the highest average ESG score (48.80), while Vietnam lags behind at 21.71, indicating substantial disparities in sustainability integration among banks. Cybersecurity disclosure is most prominent in the Philippines (0.362) and Singapore (0.320), suggesting stronger digital risk awareness. In contrast, Indonesia reports the lowest disclosure (0.151), reflecting limited transparency in this domain. Malaysia leads in board gender diversity (27.5% women on boards), while Indonesia shows the lowest representation (13.1%). Notably, the Philippines has the highest proportion of female board chairs (53.3%), whereas Singapore and Thailand report none over the study period. These findings underscore wide cross-country gaps in ESG practices, cybersecurity transparency, and gender-inclusive governance within ASEAN banks.

Table 2: Country-level Summary Statistics

	ESG Score	Coverage paragraph	Women on boards	Female chairperson
Indonesia	41.328	.151	0.131	.036
Malaysia	46.495	.236	0.275	.056
Philippines	41.402	.362	0.216	.533
Singapore	48.798	.32	0.161	0
Thailand	47.229	.23	0.202	0
Vietnam	21.714	.217	0.233	.05

Table 3 presents the results of Pearson correlation analysis to assess the potential for multicollinearity among the study variables. The results indicate that no correlation coefficient exceeds the threshold of 0.70, consistent with the criteria proposed by (Bilal et al., 2022). This suggests that the relationships among independent, mediating, and dependent variables do not pose a multicollinearity concern that could threaten the validity of the regression models. Significant yet moderate correlations—such as between coverage paragraph and women on boards (r = 0.206, $p < 0.1$), or between coverage paragraph and female chairperson (r = 0.338, $p < 0.1$)—indicate

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meaningful associations without overlapping explanatory power. These findings confirm the suitability of the variables for inclusion in the subsequent structural estimation models.

Table 3. Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) ESG_Score	1.000									
(2) Coverage_parag~h	0.195*	1.000								
(3) Coverage_word	0.152	0.584*	1.000							
(4) Women_on_boards	0.026	0.206*	0.239*	1.000						
(5) Female_chairpe~n	-0.054	0.338*	0.484*	0.101	1.000					
(6) Number_womenon~s	0.187*	0.417*	0.424*	0.816*	0.259*	1.000				
(7) numwomen1	0.043	0.278*	0.295*	0.672*	0.131	0.629*	1.000			
(8) numwomen2	0.177*	0.378*	0.455*	0.724*	0.184*	0.825*	0.553*	1.000		
(9) numwomen3	0.189*	0.291*	0.189*	0.546*	0.227*	0.808*	0.381*	0.689*	1.000	
(10) Size	0.001	-0.337*	-0.296*	-0.241*	0.034	-0.403*	-0.406*	-0.426*	-0.236*	1.000

**** p<0.01, ** p<0.05, * p<0.1*

Main Result

Table 4 reports the results of the regression models examining the effect of women's leadership on cybersecurity disclosure (CSD). In Model 1, the proportion of women on boards is positively associated with coverage paragraph ($\beta = 0.112$, $p < 0.10$), supporting Hypothesis H1a. Model 2 demonstrates that the presence of a female chairperson is also positively and significantly related to coverage paragraph ($\beta = 0.075$, $p < 0.05$), thus confirming Hypothesis H1b. These findings suggest that both board gender diversity and women's strategic leadership contribute to greater transparency in disclosing cybersecurity issues. Similar patterns are observed when the dependent variable is coverage word, with women on boards ($\beta = 0.000$, $p < 0.05$) and female chairperson ($\beta = 0.001$, $p < 0.01$) showing significant positive effects in Models 3 and 4, respectively.

Firm size is negatively associated with coverage paragraph, indicating that larger banks tend to disclose less on cybersecurity in narrative form, but positively associated with coverage word, likely due to the overall volume of disclosures. All models control for year and country fixed effects, and show acceptable explanatory power, with adjusted R^2 ranging from 0.31 to 0.49. Overall, the results provide robust evidence that women's participation in corporate boards—both in terms of presence and positional authority—positively influences the extent of cybersecurity disclosure in the banking sector.

Table 4: Main Result women leaders on cyber security disclosure

	(1)	(2)	(3)	(4)
	Coverage Paragraph		Coverage Word	
Intercept	0.523***	0.267*	-0.002***	-0.001*
	(5.288)	(0.964)	(-2.764)	(-1.914)
Women_on_boards	0.112*		0.000**	
	(1.671)		(2.425)	
Female_chairperson		0.075**		0.001***
		(2.349)		(3.809)
Size	-0.020***	-0.008	0.000***	0.000**
	(-3.718)	(-0.511)	(3.349)	(2.523)
Year	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes
Adj.R2	0.31	0.33	0.43	0.49
N	234	233	242	241
F-stat	10.817	10.909	17.228	18.207

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table 5 presents the results for the effect of cybersecurity disclosure (CSD) on ESG performance. In Model 5, coverage paragraph is positively and significantly associated with ESG score (β = 12.687, $p < 0.01$), indicating that banks with more extensive narrative disclosure on cybersecurity tend to exhibit better sustainability performance. This supports Hypothesis H2, affirming the strategic value of cybersecurity transparency in ESG outcomes. Model 6 further confirms this relationship, where coverage word also shows a positive and significant effect on ESG score (β = 2468.528, $p < 0.05$). Although the coefficient appears large, it is consistent with the very small scale of the keyword ratio variable, and reinforces the finding that even marginal increases in cybersecurity terminology within reports are associated with stronger ESG metrics.

Firm size has a positive and significant effect on ESG in Model 5 but not in Model 6, suggesting that narrative-based disclosure (paragraph) may be more closely tied to institutional maturity and stakeholder expectations than word count alone. Both models control for year and country fixed effects, with strong model fit (adjusted R^2 = 0.57 and 0.50, respectively). Taken together, these results confirm that cybersecurity disclosure plays a meaningful role in enhancing ESG performance in the banking sector, reinforcing its relevance not just for digital governance but for broader sustainability reporting.

Table 5: Main Result cyber security disclosure on ESG

	(5) ESG	(6) ESG
Intercept	-49.425***	32.976***
	(-4.738)	(4.974)
Coverage_paragraph	12.687***	
	(3.989)	
Coverage_word		2468.528**
		(2.270)
Size	4.571***	0.226
	(8.353)	(0.619)
Year	Yes	Yes
Country	Yes	Yes
Adj.R2	0.57	0.50
N	235	242
F-stat	117.498	125.796

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table 6 presents the results of the mediation analysis following the three-step approach by (Baron and Kenny, 1986). For the relationship between women on boards and ESG performance, the first step shows that women on boards significantly influence cybersecurity disclosure, measured by coverage paragraph (β = 0.218, $p = 0.001$). In the second step, coverage paragraph has a strong positive effect on ESG performance (β = 18.595, $p < 0.001$). However, the direct effect of women on boards on ESG becomes statistically insignificant in the third step (β = 3.789, $p = 0.471$). The Sobel test confirms a significant indirect effect ($z = 2.426$, $p < 0.05$), indicating a case of full mediation, thereby supporting Hypothesis H3a.

Similarly, for the influence of the female chairperson on ESG, the first and second steps show significant positive effects on coverage paragraph (β = 0.149, $p < 0.001$) and ESG (β = 23.409, $p < 0.001$), respectively. However, the direct effect of female chairperson on ESG becomes significantly negative (β = –5.073, $p = 0.019$) once the mediator is included. The Sobel test again confirms a significant mediation effect ($z = 2.559$, $p < 0.05$), which supports Hypothesis H3b and suggests that CSD fully mediates the relationship. These findings indicate that both structural (women on boards) and

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positional (female chairperson) aspects of women's leadership influence ESG performance primarily through their effect on cybersecurity disclosure. The results emphasize the central role of CSD as a governance mechanism that links inclusive leadership to broader sustainability outcomes in the banking sector..

Table 6. Mediation Analysis: The Role of Cybersecurity Disclosure

Variabel	Coverage_paragraph		ESG Score	
	(7)	(8)	(9)	(10)
Women_on boards	0.218^{***}		3.789^{***}	
	0.001		0.471	
Female_chairperson		0.149^{***}		-5.073^{***}
		0.000		0.019
Coverage_paragraph			18.595^{***}	23.409^{***}
			0.000	0.019
Control	Include	Include	Include	Include
N	233	233	233	233
Log Likelihood	-1017.379	-1220.279	-1017.379	-1220.27

Robustness Test

To ensure the reliability of the main findings, robustness checks were performed using an alternative measurement of the cybersecurity disclosure (CSD) variable, namely coverage word. As shown in Table 7, Model 11 and Model 12 confirm that both women on boards ($\beta = 0.001$, $p < 0.05$) and female chairperson ($\beta = 0.001$, $p < 0.01$) maintain significant positive effects on coverage word, thus supporting the validity of Hypotheses H1a and H1b even under alternative CSD measurement. Robustness testing for Hypothesis H2 also yielded consistent results. In Model 13 and Model 14, coverage word remains positively and significantly associated with ESG performance ($\beta = 2662.370$ and 4347.869, $p < 0.01$), confirming that cybersecurity disclosure continues to play a key role in enhancing corporate sustainability, regardless of the disclosure metric used.

Mediation analysis using coverage word as the mediator also supports the initial findings. In the third step of Model 13, the effect of women on boards on ESG becomes non-significant ($\beta = 0.182$, $p > 0.10$), while in Model 14, the effect of female chairperson on ESG turns significantly negative ($\beta = –6.606$, $p < 0.01$). The Sobel test confirms significant indirect effects in both models ($z = 2.078$ and 3.372, $p < 0.05$), indicating that coverage word fully mediates the relationship between women leaders and ESG performance. These results provide strong evidence that the mediating role of cybersecurity disclosure is robust to alternative operationalizations, reinforcing its central importance in linking gender-inclusive leadership to sustainability outcomes in the banking sector.

Table 7. Additional Mediation Analysis Using Coverage Word as an Alternative Indicator of Cybersecurity Disclosure

Variabel	Coverage_word		ESG Score	
	(11)	(12)	(13)	(14)
Women_on boards	0.001^{***}		0.182^{***}	
	0.000		0.972	
Female_chairperson		0.001^{***}		-6.606^{***}
		0.000		0.007
Coverage_word			2662.370^{***}	4347.869^{***}
			0.010	0.000

Control	Include	Include	Include	Include
N	233	233	233	233
Log Likelihood	199.114	12.3936	199.114	12.393

Endogeneity Test

To address potential endogeneity bias in the estimated relationships between women leaders, cybersecurity disclosure (CSD), and ESG performance, this study employs the Generalized Method of Moments (GMM) estimator. This approach is particularly suited for dynamic panel data with potential reverse causality or omitted variable bias (Arellano & Bond, 1991). As shown in Table 8, the Arellano–Bond tests for first-order [AR(1)] and second-order [AR(2)] serial correlation return p-values above 0.05, indicating the absence of autocorrelation in the differenced residuals and supporting the validity of the instruments (Chijoke-Mgbame et al., 2020).

Model 15 and 16 estimate the impact of women on boards ($\beta = 0.270$, $p < 0.05$) and female chairperson ($\beta = 0.120$, $p < 0.01$) on CSD, reaffirming the findings from OLS regressions. Models 17 and 18 confirm the significant influence of CSD on ESG performance, with coverage paragraph coefficients of 20.525 and 26.537 (both $p < 0.01$), consistent with prior models. Furthermore, the non-significant lagged dependent variables and favorable AR test results reinforce the robustness of the causal interpretation. These outcomes validate the hypothesized relationships (H1 and H2), suggesting that the effects of women's leadership on ESG are transmitted via transparent cybersecurity disclosure and not confounded by endogeneity..

Table 8. Endogeneity Test Results for H1 and H2 Using GMM Estimation

	(15) CSD	(16) CSD	(17) ESG	(18) ESG
Intercept	0.470***	0.581***	0.001***	0.001***
	(2.867)	(4.597)	(3.633)	(5.222)
L.Coverage_paragraph	-0.068	-0.113		
	(-0.612)	(-1.195)		
L.ESG_Score			0.012	0.009
			(0.430)	(0.305)
Coverage_paragraph			20.525***	26.537***
			(3.089)	(3.884)
Women_on_boards	0.270**		11.888	
	(2.517)		(1.606)	
Female_chairperson		0.120***		-3.475
		(3.286)		(-0.658)
Size	-0.017**	-0.021***	2.537***	2.234***
	(-2.094)	(-3.240)	(3.071)	(3.270)
AR1	0.160	0.206	0.144	0.246
AR2	0.312	0.647	0.394	0.141
N	111	111	111	111

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Additional Test

This study further explores the optimal level of female representation on corporate boards required to significantly influence cybersecurity disclosure (CSD), drawing upon Critical Mass Theory (Bluedorn & Kanter, 1978; Kanter, 1977). According to this theory, the impact of minority group members on decision-making processes strengthens once their presence reaches a certain threshold. Following (Nadia & Hanafi, 2022), the number of women on boards is categorized into three dummy variables: numwomen1 (one woman), numwomen2 (two women), and numwomen3 (three or more women). As shown in Table 9, the presence of a single woman on the board (numwomen1) does not significantly affect CSD. However, the presence of two women ($\beta = 0.042$, $p < 0.05$) and three or more women ($\beta = 0.053$, $p < 0.01$) is positively and significantly associated with increased cybersecurity disclosure. These findings support the argument that a critical mass rather than token representation—is needed for women to exert meaningful influence on governance practices, particularly in promoting greater transparency in digital risk management within the banking sector.

Table 9: Additional test: Women leaders on CSD by critical mass theory

	(1) CSD	(2) CSD	(3) CSD	(4) CSD
Intercept	0.228 (0.827)	0.158 (0.592)	0.201 (0.757)	0.507*** (5.841)
Number_womenonboards	0.022*** (2.756)			
numwomen1		0.028 (1.417)		
numwomen2			0.042** (2.070)	
numwomen3				0.053*** (2.697)
Control	Include	Include	Include	Include
Adj.R2	0.33	0.28	0.29	0.28
N	234	248	248	248
F-stat	10.873	9.830	10.562	19.249

t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

DISCUSSION

Women Leaders and Cybersecurity Disclosure

The findings of this study confirm that both the presence of women on boards and female chairpersons have a significant positive effect on cybersecurity disclosure (CSD). This underscores the strategic role of women in corporate governance, particularly in light of escalating cyber threats in the financial sector. Female leaders appear to foster greater transparency and enhance the effectiveness of digital risk disclosure. These results contrast with (Kurnia and Ardianto, 2024), who suggest that women may face participatory limitations that reduce CSD levels. In contrast, this study supports the view that women demonstrate higher risk awareness and take an active role in ensuring responsible disclosure of cybersecurity information (Francis et al., 2024; Radu & Smaili, 2022; Smaili et al., 2023).

Three key arguments explain why female board representation should be viewed as a strategic driver of CSD quality. *First*, women contribute broader and more integrative perspectives—combining analytical capability, sensitivity to risk, and empirical insight—which strengthen the board's oversight in digital risk management (Francis et al., 2024; Shakil & Abdul Wahab, 2023). Moreover, women's heightened exposure to cyber threats, particularly those of a gendered nature (Comment, 2018), further motivates their commitment to reinforcing digital protection systems. In this context, technofeminism offers a theoretical basis for women's active involvement in building inclusive and responsible technological systems (Clinnin & Manthey, 2019), while cyberfeminism extends this narrative to challenge gender-based digital crimes and inequalities (Britton et al., 2019). From the perspective of Resource Dependency Theory, women serve as strategic assets who bring legitimacy, detail orientation, and foresight in the adoption of emerging technologies.

Second, female directors typically uphold strong ethical and transparency standards. In cybersecurity matters, this is reflected in their commitment to data privacy and organizational integrity. Women are more likely to raise cybersecurity concerns during board discussions and resist withholding material information (Pucheta-Martínez et al., 2016; Radu & Smaili, 2022; Saggar et al., 2022). Their ethical approach contributes to a more open organizational culture, strengthens disclosure practices, and enhances stakeholder trust. *Third*, women often prioritize inclusive communication and stakeholder participation in strategic decision-making. They tend to align organizational policies with stakeholder needs (Al Fadli et al., 2019; Seebeck & Vetter, 2022). (Radu & Smaili, 2022) further note that women can foster constructive cognitive conflict within board deliberations, enriching dialogue and promoting deeper evaluations of risk—particularly those related to cybersecurity. The resulting outcomes include stronger collaboration, heightened risk awareness, and more responsive governance aligned with stakeholder expectations.

Cybersecurity Disclosure and ESG Performance

The results further confirm that cybersecurity disclosure (CSD) exerts a significant and positive influence on ESG performance. This finding reinforces the notion that transparent communication regarding digital security systems constitutes a critical element in strengthening corporate sustainability practices. Although direct investigations linking cybersecurity and ESG are still relatively limited, several studies highlight that data protection and privacy are key drivers of accountable and responsive corporate governance. CSD practices reflect a company's commitment to managing risks openly and responsibly, directly enhancing the governance and social dimensions within the ESG framework. Awareness of potential digital threats, coupled with transparent mitigation strategies, is a hallmark of adaptive governance that prioritizes stakeholder interests (Kamiya et al., 2021). A strong focus on data protection not only bolsters corporate credibility but also strengthens public perceptions of organizational integrity and accountability (Georg-Schaffner & Prinz, 2022).

Beyond risk communication, robust cybersecurity systems contribute to operational efficiency and long-term organizational sustainability. Particularly in the banking sector, cybersecurity disclosures serve not merely as risk communication tools but also as strategic mechanisms to mitigate the potential financial and reputational damages caused by cyber incidents. Thus, cybersecurity disclosure should not be viewed solely as a regulatory compliance requirement but rather as an integral component of corporate sustainability strategies. CSD acts as a value-added instrument of accountability that protects client data, enhances public trust in financial systems, and contributes to broader social and environmental stability.

The Mediating Role of Cybersecurity Disclosure in the Relationship between Women Leaders and ESG Performance

This study further reveals that the presence of women leaders either as board members or as top executives does not exert a direct influence on ESG performance unless mediated by enhanced cybersecurity disclosure (CSD). This indicates a full mediation effect, whereby the positive impact of women leaders on ESG performance is realized only through the strengthening of cybersecurity disclosure practices. In governance terms, women tend to adopt strategic and ethically-driven approaches; however, their tangible contribution to corporate sustainability materializes primarily through formal mechanisms such as CSD. Thus, cybersecurity disclosure emerges as the formal organizational mechanism that translates ethical leadership values, often embodied by women leaders, into measurable improvements in ESG performance.

Several factors explain this mediation effect. First, while women on boards are known to advocate for greater transparency and accountability, particularly regarding risk disclosure and information integrity (Gurol & Lagasio, 2023; Luh et al., 2024), ethical

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intentions alone are insufficient to impact ESG outcomes. These ethical stances must be translated into concrete action, with CSD serving as the critical vehicle linking values to outcomes. In this regard, the findings further validate Resource Dependency Theory (RDT), suggesting that women, as strategic actors, contribute vital resources such as legitimacy and enhanced capabilities for digital governance. Prior research by (Birindelli et al., 2018) emphasizes the importance of achieving a critical mass typically at least three women on the board to exert a substantive influence on governance structures, particularly in sensitive areas such as cybersecurity disclosure.

Second, cybersecurity disclosure is an integral component of the ESG framework, particularly within the governance and risk management dimensions. The increased representation of women on boards has been shown to heighten organizational sensitivity to digital risks (Radu & Smaili, 2022; Smaili et al., 2023), improve disclosure practices, and strengthen stakeholder trust. Consequently, women in leadership positions indirectly enhance ESG performance by promoting robust cybersecurity disclosure initiatives that protect data privacy, foster transparent governance systems, and reinforce corporate credibility among broader stakeholders.

CONCLUSION

This study examines the impact of women's leadership on Environmental, Social, and Governance (ESG) performance, with cybersecurity disclosure (CSD) positioned as a mediating variable, within the ASEAN banking sector. Using panel data from 46 banks across six countries (2017–2022) and employing regression and mediation analyses, three key findings emerge. First, women on boards and female chairpersons significantly enhance CSD, highlighting their role in promoting transparent digital risk reporting. Second, CSD positively influences ESG performance, emphasizing its critical role in strengthening governance and social accountability. Third, the influence of women leaders on ESG is fully mediated by CSD, confirming that their strategic contribution to sustainability materializes through robust disclosure practices. These results validate Resource Dependency Theory, positioning women as strategic agents in advancing digital governance.

The findings offer several policy implications. Governments should not only increase female representation on boards but also position women in strategic leadership roles, supported by expanded access to STEM education in line with SDG 5 goals. Countries are also encouraged to integrate cybersecurity into national ESG frameworks to formalize digital risk management as part of corporate accountability. At the global level, the Global Sustainability Standards Board (GSSB) should develop dedicated cybersecurity disclosure standards within the GRI framework. Finally, in Indonesia, enhanced cross-ministerial coordination is needed to embed cybersecurity within sustainable finance strategies, reinforcing financial system resilience and competitiveness.

LIMITATION

This study enriches the literature on the intersection of gender, cybersecurity, and sustainability in the banking sector by emphasizing the mediating role of cybersecurity disclosure (CSD) in the relationship between women's leadership and ESG performance. Practically, the findings advocate for gender equality and the strengthening of digital governance as integral components of achieving the SDGs within the financial industry. However, this study has certain limitations. First, its scope is confined to the banking sector, limiting the generalizability of the findings to other industries. Second, it does not account for the qualitative attributes of women's leadership, such as educational background, experience, and professional certifications.

Future research is encouraged to broaden the industrial context and assess individual leadership qualities as determinants of sustainable governance success.

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DECLARATION OF CONFLICTING INTERESTS

The author declares that there are no potential conflicts of interest with respect to the research, authorship, and/or publication of this paper.

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ABOUT THE AUTHOR

1st Author
Zainuddin is a doctoral student in Accounting at Universitas Airlangga, Indonesia. He began his doctoral studies in August 2023 and is actively enrolled in the 2024/2025 academic year. His research interests focus on the field of accounting, with a dedication to contributing to academic knowledge and advancing the discipline.

2nd Author
Bambang Tjahjadi is a permanent faculty member at Universitas Airlangga, specializing in Accounting. He earned his Doctoral degree (Ph.D.) in Accounting and continues to actively contribute to the academic community through teaching, research, and scholarly publications. With a strong commitment to advancing knowledge in the field of accounting, he remains actively engaged in various academic and professional activities.