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Abdulrahman Alomair
King Faisal University
Ahmad F. Almutairi
Public Authority for Applied Education and Training
Abdallah A.S. Fayad
abdallahasfayad@gmail.com

Universiti Teknologi MARA
Khaled O. Alotaibi
Public Authority for Applied Education and Training
Nur Hayati Ab Samad
Universiti Teknologi MARA
Meshari Al-Daihani
University of Malaya

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1.Abdulrahman Alomair, 2.Ahmad F. Almutairi 3. Abdallah A.S. Fayad* 4. Khaled O. Alotaibi 5. Nur Hayati Ab Samad 6. Meshari Al-Daihani

1. Assistant professor of Accounting, Accounting Department, Business School, King Faisal University, Al-Ahsa 31982, Saudi Arabia, Email: aamalomair@kfu.edu.sa https://orcid.org/0000-0001-7493-7822

2. Assistant professor of Accounting , Accounting Department, College of Business Studies, Public Authority for Education and Training, afe.almutairi@paaet.edu.kw

3. Assistant professor of Accounting , Faculty of Accountancy, Universiti Teknologi MARA Cawangan Selangor, Kampus Puncak Alam, 42300, Selangor, Malaysia. Email: abdallahasfayad@gmail.com. ORCID: https://orcid.org/0000-0001-9981-2524

4. Associate Professor, Management Department, College of Business Studies, Public Authority for Education and Training, ko.alotaibi@paaet.edu.kw, ORCID: 0000-0003-3749-8431

5. Assistant professor of Accounting , Faculty of Accountancy, Universiti Teknologi MARA Cawangan Selangor, Kampus Puncak Alam, 42300, Selangor, Malaysia. Email: nurhayati321@uitm.edu.my ORCID : 0000-0001-6917-5894

6. Assistant professor , Academy of Islamic Studies ,University of Malaya , 50603 Wilayah Persekutuan Kuala Lumpur, Malaysia Email: meshari89.r@gmail.com ORCID: https://orcid.org/0000-0001-6821-7052

Abstract

Focusing on public listed companies in Malaysia over the 2018–2023 period, this study explores their Environmental, Social, and Governance (ESG) performance as determined by temporal dynamics, sectoral variation, and governance factors. More specifically, the study examines the effect of sectoral variation and board gender di-versity on ESG achievement by leveraging the Stakeholder Theory, Resource-Based View, and Institutional Theory. A panel dataset and fixed-effects regression mod-els encompassing interaction terms are employed for this purpose, leading to three primary findings. The first key finding indicates a significant and gradual decline in ESG performance post-2020, showing how fragile sustainability commitments are against external pressures. Secondly, there are notable cross-sector variations in ESG scores with construction, manufacturing, and healthcare leading ahead of agriculture and utilities. Finally, board gender diversity shows no consistent effect on ESG performance; it does, however, pose certain positive effects on some in-dustries. Collectively, these findings in the context of emerging markets mean that ESG engagement is intricately driven by the combination of institutional pressures, industry norms, and governance structures. Contributing to ESG literature, this study demonstrates how context-specific governance mechanisms and sector-based policy interventions can crucially promote corporate sustainability.

Keywords: ESG performance; Gender diversity; Corporate governance; Sectoral analysis; Emerging markets; Malaysia

1 Introduction

There has been rising attention on Environmental, Social, and Governance (ESG) performance in the development of corporate strategies, investment decisions, and regulatory matters in recent times (Fayad et al., 2024; Ahmad et al., 2023). With the prevalence of climate change, social inequality, and corporate accountability, ESG metrics have now become key indicators of value creation and risk mitigation in the long-run (Meinhold et al., 2026). Apart from providing financial oversight, boards of directors today are also accountable for matters related to sustainability and ethical governance (Kolk, 2008). It is at this juncture that the role of gender diversity becomes apparent, specifically in driving corporate sustainability (Amorelli & García-Sánchez, 2021). The presence of female directors has been linked to improved stakeholder engagement, ethical sensitivity, and inclusive decision-making on boards, all of which are a part of ESG objectives (Aladwan et al., 2025; Bose et al., 2022). It is this connection between ESG performance and board gender diversity that has gained the interest of academia and policy-related discourses.

But even with such global attention, empirical findings on ESG and gender diversity are mostly concentrated in developed countries of which institutional frameworks, regulatory administration, and market structures are far different from their emerging counterparts (Wasiuzzaman & Subramaniam, 2023; Singhania & Saini, 2023). Research in the context of Malaysia fills this gap. The country has been actively promoting sustainability efforts via Bursa Malaysia and the Securities Commission, encompassing ESG reporting guidelines and the Sustainable and Responsible Investment (SRI) framework (Sivanandan, 2026; Jamaludin et al., 2025). The country has also been pushing for greater female corporate representation, formally targeting public listed entities (Abdullah et al., 2016; Alazzani et al., 2019; Ahmad et al., 2018). Even so, Malaysia showcases an imbalance in the adoption of ESG adoption and board diversity across sectors, whereby levels of regulatory pressure, stakeholder scrutiny, and resource capacity vary greatly. Sectoral dynamics potentially mediates the effect of gender diversity on the firms' ESG engagement (Kampoowale et al., 2025).

Therefore, this study sets out to explore the evolution of Malaysia's ESG performance across industries, and whether it is influenced by gender diversity. This is in direct response to the call of previous works to examine the links between sectoral, temporal, and governance factors. Four primary research objectives guide this study: (1) to analyze how ESG has temporally evolved in Malaysian listed firms, focusing on each E, S, and G component; (2) to identify the differences in ESG performance across sectors; (3) to determine if female representation on boards improves ESG, E, S, and G performance; and (4) to examine if sectoral effects on ESG performance is shaped by the presence of female directors. These research questions operationalize the aforementioned objectives: How have ESG scores (and each component) evolved over the years in Malaysia? Do Malaysian sectors differ significantly in E, S, and G performance? Are firms with greater female board representation more committed to ESG and its components? Does female board participation moderate the relationship between sectoral characteristics and ESG scores?

Towards this end, a quantitative research design is employed, involving a panel dataset of public listed firms in Malaysia over the 2018–2023 period. The environmental, social, and governance components of ESG data were evaluated, along with board composition variables and sectoral groupings. Methodology wise, the study employs descriptive statistics, ANOVA and MANOVA tests to determine the sectoral and temporal mean differences, and fixed-effects regression models with interaction terms to identify moderating effects. Three patterns are discovered: (1) a gradual decline in ESG performance post-2020; (2) significant sectoral differences, showcasing the dominance of manufacturing, construction, and healthcare; and (3) the non-uniform effect of gender diversity on ESG performance; however, it positively but conditionally affects certain sectors. All these indicate the intricacies of ESG performance in Malaysia, driven by institutional, industrial, and governance factors.

This study's implications are both theoretical and practical. It offers greater theoretical insight on ESG performance in the context of emerging nations, placing it between sectoral dynamics and board governance, breaking the assumptions of uniform progress and linear causality. In the practical sense, the findings are beneficial for Malaysian firms, regulators, and investors as well as other similar contexts. Firms learn the significance of streamlining sustainability strategies with industry expectations, making use of the value of board diversity. Meanwhile, policymakers learn about the need to integrate sectoral readiness and inclusive governance practices into the development of ESG policies. Investors learn about the significance of gender composition and sectoral characteristics in the evaluation of ESG risks and prospects. By showing the limitations of ESG engagement and imbalance in sustainability performance, this study improves understanding about corporate responsibility in the dynamic Malaysian landscape.

Henceforth, the study's theoretical framework and hypotheses are presented in Section 2. Literature on ESG, gender diversity, and corporate governance in emerging markets is reviewed in Section 3. Data sources, development of variables, and the research methodology are outlined in Section 4. The empirical results for temporal trends, sectoral comparisons, and regression analyses are presented in Section 5. Research implications are discussed in Section 6, and lastly, the summary of key findings, theoretical and practical contributions, policy implications, study limitations, and directions for future research are presented in Section 7.

2. Theoretical Framework

A robust theoretical underpinning is needed to capture the evolution of Environmental, Social, and Governance (ESG) performance in Malaysian firms, so as to better understand the dynamics between internal governance structures and external institutional landscape. Hence, the Stakeholder Theory, Resource-Based View (RBV), and Institutional Theory are employed as the research underpinnings due to their comprehensive nature for assessing the links between board gender diversity, sectoral factors, temporal factors, and ESG outcomes in emerging nations.

Freeman's (1984) Stakeholder Theory asserts that aside from the aim of maximizing shareholder value, firms also serve the interests of various stakeholders encompassing employees, customers, regulators, communities, and the environment. This theory is highly relevant to the ESG context, as sustainability performance is deemed to reflect a firm's ability to fulfill stakeholder interests (Freeman, 1984; Gavana et al., 2024). In Malaysia, this emphasis on stakeholder interest is being addressed through the growing focus on ESG as spurred by Bursa Malaysia's sustainability reporting framework and the Malaysian Code on Corporate Governance (MCCG) (Raja Ahmad et al., 2025; Kamaludin et al., 2022).

Stakeholder governance is critically related to female director representation on corporate boards due to this gender's greater attention to ethical considerations, risk management, and stakeholder engagement, i.e., crucial aspects of ESG performance (Agustina & Barokah, 2024; Kampoowale et al., 2024). Malaysian case studies have proven this claim, demonstrating the correlation between greater female director representation and improved ESG disclosure as well as performance outcomes (Kamaludin et al., 2022; Putri Agustina & Barokah, 2024; Raja Ahmad et al., 2025).

Different from the outward perspective of the Stakeholder Theory, the Resource-Based View (RBV) looks internally to understand the development of sustainable competitive advantage. Barney (1991) states that the attainment and usage of valuable, rare, inimitable, and non-substitutable (VRIN) resources determine the performance of firms. In line with this assertion, gender-diverse boards are deemed a strategic resource capable of improving the ESG performance of a firm. Sustainability decision-making improves with the unique thinking, leadership, and social views of female directors (Kampoowale et al., 2024; Wan Mohammad et al., 2022).

The RBV's utility for ESG governance has been demonstrated in several Malaysian-based studies. Board gender diversity, according to Kampoowale et al. (2024), has a positive direct and mediating effect on ESG and financial performance. Raja Ahmad et al. (2025) also

indicated the positive impact of board independence and gender diversity on sustainability outcomes, serving as internal resources for improving ESG performance. All these findings support the RBV's suggestion that strategically formed internal governance can result in sustained competitive advantage (Rahayu Putri Agustina & Barokah, 2024; Shaheen et al., 2025).

DiMaggio and Powell's (1983) Institutional Theory assumes legitimacy attainment via adherence to external norms, rules, and expectations. In relation to ESG, coercive (regulations), normative (industry standards), or mimetic (peer emulation) institutional pressures all spur sustainability practices and disclosures (Wasiuzzaman & Abdul Wahab, 2025; Latif et al., 2020). The MCCG 2021 and Bursa Malaysia's sustainability reporting guidelines are among the examples of coercive and normative pressures driving corporate ESG behavior in Malaysia (Raja Ahmad et al., 2025; Kamaludin et al., 2022).

These institutional factors have been shown to pose specific sectoral impacts. To illustrate, construction and industrial firms in Malaysia often demonstrate high ESG scores owing to strict environmental regulations and public scrutiny in the country (Raja Ahmad et al., 2025; Kamaludin et al., 2022). Utilities and agriculture firms, meanwhile, typically have low ESG performance because of weak institutional mandates or low stakeholder pressure (Kampoowale et al., 2024). All these prove that institutional environments play a role in influencing ESG outcomes.

The institutional theory also emphasizes temporal dynamics. With the maturity of regulatory frameworks and growing public expectations, ESG practices undergo gradual evolution as well. ESG performance in Malaysia showed major improvements post-2014, following mandatory governance reforms and more stringent reporting demands (Kamaludin et al., 2022). But more recently, some sectors have been showing decreased ESG performance owing to implementation fatigue or slower regulatory momentum (Putri Agustina & Barokah, 2024).

Together, these theoretical underpinnings conceptually explain how ESG performance, gender diversity, sectoral variation, and temporal change intertwine. ESG is a multidimensional construct entailing environmental, social, and governance dimensions (Kampoowale et al., 2024; Samidi & Kwan, 2024). Each is affected in its own way by internal governance mechanisms and external institutional factors. To illustrate, female directors have been shown to focus more on the social and governance components as opposed to the environmental dimension (Alazzani et al., 2017; Wasiuzzaman & Abdul Wahab, 2025).

ESG behavior has been shown to be affected by sectoral factors like regulatory expectations, stakeholder activism, and industry norms. Manufacturing and construction sectors, for

example, tend to comply to ESG reporting to retain their legitimacy and manage risks considering their significant impact on the environment (Raja Ahmad et al., 2025; Kampoowale et al., 2024). Sectors without much stakeholder scrutiny, in contrast, comply less to ESG disclosures (Wasiuzzaman & Abdul Wahab, 2025).

Apart from its direct effect on ESG performance, gender diversity may also pose a moderating effect. Sectors under major regulatory scrutiny or with high stakeholder visibility could benefit from the presence of female directors who are more concerned about ethics and stakeholder engagement, leading to greater ESG responsiveness (Kamaludin et al., 2022; Wan Mohammad et al., 2022). In contrast, female directors would have less effect in sectors with weak ESG norms characterized by institutional inertia or tokenism (Najaf et al., 2024; Kampoowale et al., 2024).

In this unified theoretical framework, ESG performance is framed as being driven by stakeholder expectations, internal resources (e.g., board diversity), and institutional environments. Sectoral and temporal factors, meanwhile, help shape the interactions between these forces. Corporate Malaysia's regulatory evolution, sectoral heterogeneity, and rising instances of board inclusivity offer fertile ground for examining these interactions. This framework is hence employed to underpin the examination of ESG performance as driven by sectoral and temporal factors, and of the moderating effect of female directors.

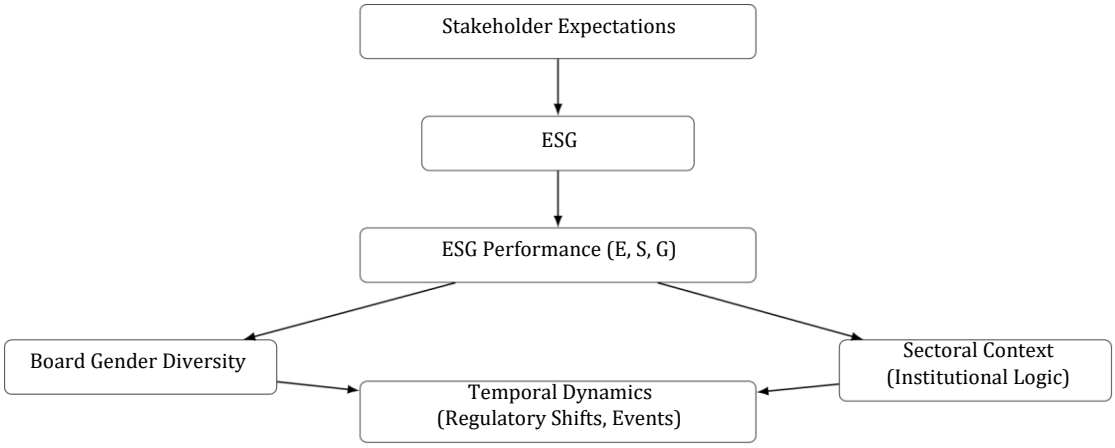


Figure 1: Conceptual framework linking stakeholder expectations, governance resources, institutional environments, and ESG performance across sectors and time.

3. Literature Review

ESG performance is now becoming more and more important for corporate strategy, notably in markets with high regulatory and stakeholder demands like that of Malaysia. Board gender diversity, in particular, has been receiving growing research attention due to its effect on ESG performance. Findings, however, are mixed with regards to the effect of sector, time, and governance on ESG performance. This study hence identifies four key themes to support its conceptual framework and hypotheses.

3.1 ESG Performance and Sectoral Differences

Corporate sustainability, transparency, and ethical governance are now increasingly being measured against ESG performance. The Environmental (E), Social (S), and Governance (G) dimensions are measured using standard global criteria like the Global Reporting Initiative (GRI, 2021), SASB, and TCFD. But ESG disclosures remain very sector-sensitive, indicating varying industry-wide environmental risks, stakeholder expectations, and regulatory obligations.

The Institutional Theory (DiMaggio & Powell, 1983) elucidates how organizational behavior is determined by sectoral norms and pressures. Energy, construction, and manufacturing firms, due to their great environmental impact, typically encounter strong institutional pressures in the form of environmental regulations, disclosure mandates, and public scrutiny (Latif et al., 2020; Wasiuzzaman & Abdul Wahab, 2025). Less regulated sectors, in contrast, show lower ESG transparency and performance (Fayad et al., 2024).

This view is reinforced by Raja Ahmad et al. (2025) who found major sectoral differences across Malaysian public firms, where industrial and construction firms often topping the ESG scores of agricultural and utilities firms. Kampoowale et al. (2024) also observed greater ESG disclosures among firms in high-impact sectors, especially on the environmental dimension, spurred by these sectors' high regulatory visibility and risk exposure.

Wang et al. (2023) likewise found significantly higher ESG disclosures in sectors with strict environmental regulations in the context of ASEAN-5. Back to Malaysia, Najaf et al. (2024) documented consistent governance and social scores across sectors, whilst environmental scores are often bounded by industry regulations. Samidi and Kwan (2024) showed Malaysia's ESG ratings are directly affected by sectoral compliance and perceived environmental risk. Based on the study's regression analysis, ESG score variance is strongly predicted by sectoral factors, even against firm size and profitability.

All these findings are aligned with the Stakeholder Theory (Freeman, 1984) which underscores sector-specific stakeholder accountability. Retail or finance firms, for example, are typically spurred by reputational concerns and investor demands, highlighting the need for social and governance metrics. Extractive or industrial firms, meanwhile, focus more on environmental disclosures to remain legitimate in the eyes of regulators and communities (Agustina & Barokah, 2024; Wen et al., 2025).

In Malaysia, the MCCG 2021 and Bursa Malaysia's sustainability disclosure mandate in particular affect sectors in a non-uniform manner. Kamaludin et al. (2022) stated that ESG reporting quality and depth vary significantly across listed firms, whereby heavy industries focus more on environmental disclosure whilst service sectors provide more information regarding governance and stakeholder engagement.

Hence, sectoral factors do crucially affect ESG performance. ESG, E, S, and G scores have been shown to be uneven across sectors, but are affected by institutional environments, stakeholder dynamics, and industry materiality levels. Based on all the above, we propose that:

H1*: ESG, E, S, and G scores differ significantly across sectors.*

3.2 Temporal Trends in ESG Performance

Temporal dynamics crucially shapes ESG performance, mainly due to changes in regulatory frameworks, public awareness levels, and market expectations. The gradual institutionalization of ESG practices is caused by external pressures and internal adaptations. The Institutional Theory supports this assertion by explaining about temporal isomorphism, whereby organizational behaviors are adapted to suit current institutional logics (DiMaggio & Powell, 1983; Scott, 2014).

ESG reporting in emerging nations has notably evolved in tandem with regulatory milestones. ESG disclosures among Malaysian firms have evolved along with updates to the Malaysian Code on Corporate Governance (MCCG) (2012, 2017, and 2020) and Bursa Malaysia's Sustainability Reporting Framework. Such regulatory interventions have been shown to boost ESG transparency, notably among large-cap and government-linked firms (Kamaludin et al., 2022; Samidi & Kwan, 2024).

The COVID-19 pandemic had boosted stakeholder demands for corporate resilience, social responsibility, and ethical supply chains. Agustina and Barokah (2024) and Wang and Lee (2023) observed improvements in ESG scores post-2020, especially in the social and governance dimensions, due to active communications about crisis response, employee protection policies, and board oversight. Najaf et al. (2024) found positive temporal shifts in ESG scores over the 2018–2023 period due to greater ESG rating integration by investors and the effect of global sustainability indices.

Firms have also been motivated by market-based factors like ESG-linked financing, investor activism, and ESG rating agencies (e.g., FTSE4Good Bursa Malaysia Index) to improve their ESG scores. Also in Malaysia, Kampoowale et al. (2024) found progressive alignment between ESG disclosures and global standards post-2019, when ESG compliance was made mandatory for certain investment portfolios.

The Legitimacy Theory also supports temporal variation, suggesting that firms gradually adjust their ESG reporting to keep their social license and legitimacy amidst a changing landscape (Suchman, 1995). With greater stakeholder expectations, firms become more pressured to prepare robust and integrated ESG disclosures. Even so, there is no uniformity in temporal progress. Some firms have consistently improved, while some others continue to be constrained by poor resources and enforcement on top of having no stakeholder pressure. Based on Wasiuzzaman and Abdul Wahab (2025), ESG maturity is influenced by firm size and ownership structure, whereby smaller firms and those owned by family show slower ESG progression.

The literature as a whole agrees about the dynamic nature of ESG performance, being affected by regulations, market conditions, and societal demands. This brings us to the second hypothesis:

H2: ESG and its components show significant temporal variation.

3.3 Gender Diversity on Boards and ESG Outcomes

Research has identified board gender diversity as a key factor driving corporate governance reform, especially in relation to Environmental, Social, and Governance (ESG) score improvement. Female directors have been linked to better board transparency, ethical oversight, and stakeholder engagement, in line with sustainable and responsible business principles. The Stakeholder Theory (Freeman, 1984) states that diverse boards offer greater stakeholder responsiveness, thus boosting corporate accountability and ESG performance. The Resource-Based View (Barney, 1991) also highlights gender diversity as a strategic intangible asset for improving legitimacy, social capital, and innovation, all of which drive sustainability.

There is growing recognition of the positive impact of board gender diversity on ESG scores. Kamaludin et al. (2022) in their 15-year panel analysis of 91 listed Malaysian firms revealed the significant positive impact of female directors on ESG performance, notably with regards to the social and governance dimensions. Opposing earlier claims of tokenism (e.g., Alazzani et al., 2019), the study's findings highlight the significant impact of female directors in driving corporate sustainability. With their usage of structural equation modelling, Kampoowale et al. (2024) revealed the full mediation role of ESG performance in the link between board gender diversity and financial metrics like Tobin's Q and ROA. This reinforces the idea that gender diversity both drives and enables organizational performance via ESG. Agustina and Barokah

(2024) likewise discovered that gender diversity in the boardroom results in better stakeholder outcomes, as exemplified by how well Malaysian and Indonesian firms took care of their employees' welfare and engage with the community during the COVID-19 situation.

Wasiuzzaman and Abdul Wahab (2025) also showed the strong positive impact of board gender diversity on ESG scores in institutionally accountable countries, highlighting how board effectiveness is crucially shaped by the regulatory and governance landscape. Even so, some other studies did not find gender diversity as being significant for ESG outcomes, notably when the presence of female directors is low. This is where theories of tokenism and critical mass come into play. Tokenism refers to non-significant impact when the number of female directors is low, while the critical mass theory suggests the need for at least 30% female directors on the board for them to wield any sway in decision making (Torchia et al., 2011; Terjesen et al., 2016; Al Naim & Alomair, 2025).

Raja Ahmad et al. (2025) found evidence of improved ESG performance when the board is gender-diverse and majorly independent. Kampoowale et al. (2024) brought forth the impact of sectoral factors, stating that gender diversity has greater ESG impact in the finance and consumer goods sectors which are faced with greater stakeholder scrutiny and reputational risks. Meanwhile, ESG performance in capital-driven sectors like manufacturing is influenced more by regulatory compliance than board-related factors including gender diversity. Samidi and Kwan (2024) likewise indicated that Malaysian industries with greater focus on compliance register higher ESG scores, denoting the mediation role of institutional monitoring.

All these findings empirically show that boardroom gender diversity can drive ESG performance, especially when there's a greater number of female directors in a facilitative institutional, regulatory, and sectoral setting. We hence propose that:

H3: Female board representation is positively associated with ESG, E, S, and G scores.

3.4 Gender Diversity as a Moderator in Sectoral ESG Performance

Institutional, operational, and reputational factors all shape how the sectoral determinant affects ESG disclosures (Baldini et al. 2018). Different industries have different levels of exposure to environmental risks, regulatory oversight, stakeholder visibility, and public demands. Firms in energy, infrastructure, and heavy manufacturing sectors (which are highly resource based) are scrutinized more for their environmental practices. Finance, healthcare, and consumer-based businesses, on the other hand, are monitored more for their social governance and ethical practices. Such distinct sectoral factors result in varying incentives and limitations for carrying out ESG strategies.

As such, board composition plays a role in how firms handle sector-specific ESG demands. Evidence states that female directors can lead to improved stakeholder orientation, ethical assessment, and focus on social and environmental risks. This is even more relevant in sectors with high ESG demands, prompting the need for gender diversity to reinforce ESG responsiveness.

While the direct effects of gender diversity on ESG performance have been substantially studied, its **moderating role** in sector–ESG relationships remains under-examined. Recent studies, however, have looked into this moderation effect. Kamaludin et al. (2022) indicated major variations in industry-wide ESG scores in Malaysia, with board diversity showing strong effects on sectors subjected to high stakeholder demands like consumer staples and industrial. Wasiuzzaman and Abdul Wahab (2025) likewise demonstrated the modulating effect of institutional accountability on board gender diversity, indicating the roles of industry norms and regulatory environments in influencing outcomes.

Kampoowale et al. (2024) asserted that board gender diversity has a more positive effect on ESG outcomes in sectors facing high stakeholder scrutiny like finance and services, as opposed to the more capital- and regulatory-oriented sectors of construction and manufacturing. Added to this is the proof by Ebnaoof (2025) that female directors' ability to improve environmental innovation depends on how effective the audit committee performs. This finding underscores the importance of governance aspects as well as board attributes in shaping ESG outcomes within specific contexts.

Supporting this view are cross-country studies like that of Agustina and Barokah (2024) which revealed the non-homogeneous effect of female directors on Indonesia and Malaysia's ESG outcomes, with industries centered on human capital and social impact receiving greater effects. In the case of ASEAN banks, Al-Jaifi (2020) found that board gender diversity boosts governance performance but not environmental and social outcomes. This is another proof of sectoral factors affecting the impact of gender diversity.

Samidi and Kwan (2024) found that ESG ratings in Malaysia are higher in sectors with established compliance standards, and that board characteristics like gender diversity help distinguish firms in such sectors. Ahmad et al. (2025) highlighted the reinforcing effect of board independence in the link between gender diversity and ESG performance, but only in industries focused on sustainability. This suggests that sectoral, governance, and board composition determinants are intricately intertwined.

Together, these findings indicate the complex interplay between **industry characteristics,** strategic orientation, and board composition in determining ESG outcomes. Gender diversity can help achieve ESG demands in sectors characterized by high stakeholder engagement, ethical sensitivity, and reputational risk. But its effect may be less prominent in sectors where ESG compliance is merely procedural or board decisions are subjected to technical or regulatory decrees.

With such non-uniform effect, gender diversity is better off conceptualized as a **moderating variable** for improving ESG performance, especially in sectors with high levels of visibility, stakeholder pressure, or reputational risks. Hence, we propose that:

H4: *Female directors moderate the sector–ESG relationship, strengthening sustainability performance in specific sectors.*

4. Methodology

4.1 Data and Sample

A panel dataset of public listed non-financial firms on Bursa Malaysia covering the 2018–2023 period is employed in this study. Data on ESG are derived from Refinitiv® Eikon highly prominent ESG Disclosure Scores which are the combined calculations of voluntary and mandatory disclosures, sustainability reports, and third-party data. This allows for consistent and comparable findings across firms over time (Khan et al., 2016).

Financial institutions are excluded from this analysis as they are subjected to their own regulatory setting and capital structure (Haniffa & Cooke, 2002). Also excluded are firms without data on board composition, ESG scores, or other financial indicators. The final panel comprises 132 firms and 792 firm-year observations across various sectors such as consumer, industrials, technology, healthcare, property, and energy. The Bursa Malaysia sectoral taxonomy is used as reference for classifying the sectors (Bursa Malaysia, 2023).

4.2 Variables and Measures

The interaction between female board representation and sectoral affiliation and the said relationship's effect on ESG performance are examined in this study. Overall ESG score serves as the main dependent variable, along with the scores of its individual Environmental (E), Social (S), and Governance (G) components. Female board representation and sectoral dummies serve as the main independent variables, and the moderating effect is tested using the interaction terms. The controls are firm size, leverage, board size, and board attendance, i.e.,

all standard constructs in corporate governance and ESG scholarship (Wasiuzzaman & Abdul Wahab, 2025; Khan et al., 2016).

4.3 Estimation Strategy

There are three main stages to the empirical analysis: (1) descriptive and group difference analysis, (2) baseline panel regression models, and (3) interaction models for testing the moderating effect. To ensure clarity, each model is assigned a number.

Model 1: Descriptive Statistics and Group Differences

This stage sums up all the variables' distribution, central tendency, and variability. The next step entails:

- ANOVA (Analysis of Variance) for testing any significant variances in the mean ESG scores across sectors.
- MANOVA (Multivariate Analysis of Variance) for determining sectoral variances across the E, S, and G components, concurrently.

By doing so, we can identify if sectoral affiliation has any major bearing on ESG performance before undergoing regression (Hair et al., 2019).

Model 2: Baseline Panel Regression (Direct Effects)

This stage examines the direct link between gender diversity, sectoral drivers, and ESG performance. Fixed-effects (FE) and random-effects (RE) estimators are used for estimating the following model:

$$ESG_{it}=\beta_0+\beta_1 Female_{it}+\sum\beta_2 Sector_i+\beta_3 X_{it}+\mu_i+\varepsilon_{it} \quad (1)$$

Where ESG_{it} is the ESG score for firm *i* at time *t*

$Female_{it}$: percentage of female directors

$Sector_i$: sector dummy variables

X_{it}: vector of controls (size, leverage, board size, attendance)

μ_i: unobserved firm-specific effect

ϵ_{it}: idiosyncratic error

The suitability of either FE or RE is determined by the **Hausman test** (Baltagi, 2021).

Model 3: Moderation Model (Female × Sector)

H4 is tested using this model, i.e., to determine the moderating role of female board representation in the link between sectoral drivers and ESG performance:

$$ESG_{it}=\beta_0+\beta_1 Female_{it}+\sum\beta_2 Sector_i+\beta_3(Female_{it}\times Sector_i)+\beta_4 X_{it}+\mu_i+\varepsilon_{it} \quad (2)$$

If the interaction term is significant, then female board representation poses varied sector-specific effects on ESG, as per the **moderation** theory's assertion (Aiken & West, 1991; Terjesen et al., 2016).

Model 4: ESG Pillar-Specific Regressions

Individual panel regressions are performed for the **Environmental, Social,** and **Governance** scores to determine the most affected ESG component:

$$E_{it}=\beta_0+\beta_1 Female_{it}+\sum\beta_2 Sector_i+\beta_3(Female_{it}\times Sector_i)+\beta_4 X_{it}+\mu_i+\varepsilon_{it} \quad (3)$$

$$S_{it}=\beta_0+\beta_1 Female_{it}+\sum\beta_2 Sector_i+\beta_3(Female_{it}\times Sector_i)+\beta_4 X_{it}+\mu_i+\varepsilon_{it} \quad (4)$$

$$G_{it}=\beta_0+\beta_1 Female_{it}+\sum\beta_2 Sector_i+\beta_3(Female_{it}\times Sector_i)+\beta_4 X_{it}+\mu_i+\varepsilon_{it} \quad (5)$$

These models identify which ESG component showcases the most prominent link between gender diversity and sectoral factors.

5. Results

5.1 Descriptive Statistics

The descriptive statistics for the key variables are presented in Table 1. All the firm-year observations attained an average ESG score of 59.50, with a wide standard deviation of 12.84, indicating that the listed Malaysian firms have major variations in ESG performance. The minimum ESG score of 26.91 and maximum of 91.66 indicate laggards and drivers of sustainability.

The social dimension has the greatest average score at 63.71, governance at 59.36, and environment at 53.01. This means that Malaysian firms focus more on social and governance practices as opposed to environmental efforts. Past studies have likewise indicated the non-focus on environmental initiatives owing to regulatory, financial, or institutional limitations (Alazzani et al., 2019).

The mean score for board gender diversity is 25.45%, despite the wide dispersion shown between firms with zero female directors and those with high female representation. This finding denotes a large gap across firms with regards to the adoption of gender diversity policies. Board size has a mean score of 9.08 directors, which is common in this region. Leverage shows a mean ratio of 0.54, indicating the firms' moderate dependence on debt financing.

These results form an empirical basis for examining variations in ESG scores within-firm and between-firms. The heterogenous outcomes for the key governance and financial variables prove the need for further multivariate analysis.

Table 1. Descriptive statistics of ESG and governance variables

Variable	Mean	SD	Min	Max
ESG score	59.499	12.840	26.908	91.662
Environmental (E)	53.007	19.166	11.210	94.466
Social (S)	63.711	13.736	31.382	97.426
Governance (G)	59.362	20.275	14.199	95.435
Female board	0.254	0.120	0.000	0.571
Board size	9.079	1.847	1.000	14.000
Firm size (ln assets)	22.183	1.033	19.343	24.569
Leverage	0.540	0.211	0.077	1.308

5.2 Sectoral Differences in ESG Performance

Table 2 presents the results for the initial ESG performance assessment. It is found that the ESG scores are highly disparate across sectors. Construction, Manufacturing, Healthcare, and Transportation & Warehousing show high ESG scores, averaging more than 60. In contrast, Agriculture and Utilities record below average ESG mean scores.

This leads to the question of whether sectoral factors have any significant influence on ESG outcomes. Table 4 presents the one-way analysis of variance (ANOVA) results. An F-statistic of 2.82 and p-value of 0.0027 are derived, denoting statistically significant differences in the ESG mean scores across the 11 sectors studied. Hence, the sectoral factor significantly affects ESG performance.

H1 is hence strongly supported, confirming that industry-related factors have a significant sway on ESG performance. Implications-wise, due to the non-uniform effect of ESG strategies across sectors, policy and regulatory developments must hence take into account industry-specific operational and institutional attributes.

Table 2: Mean ESG scores by sector

sector	ESG score
Accommodation and Food Services	56.669
Agriculture, Forestry, Fishing and Hunting	53.188
Construction	65.707
Health Care and Social Assistance	62.670
Information	55.275
Manufacturing	63.310
Mining, Quarrying, and Oil and Gas Extraction	56.571
Retail Trade	55.454
Transportation and Warehousing	61.288
Utilities	52.964
Wholesale Trade	55.454

Table 3: ANOVA results for ESG by sector

Statistic	N	F	df (model)	df (residual)	p-value	R2
ANOVA	216	2.8222	10	205	0.0027	0.121

5.3 Temporal Dynamics of ESG Scores

Table 4 demonstrates a gradual and continuous decline in ESG performance throughout the period under study. From 66.68 in 2018 to 52.05 in 2023, the average ESG score dropped over 14 points in a six-year timeframe. This phenomenon is very concerning as it depicts a decreasing focus on sustainability.

Table 6 presents more evidence of this trend, showing the panel regression models' negative and statistically significant year-fixed effects post-2020. To illustrate, the 2020–2023 coefficients are all significant at the 1% level, ranging from –4.77 to –14.33. This means that the drop in ESG score is not random; it is a rather systematic and statistically robust phenomenon.

H2 is hence confirmed, indicating significant temporal variations in ESG performance. The drop occurred during global events like COVID-19 and various economic disruptions, which explains the lower focus on sustainability efforts. The resilience of ESG efforts during crisis situations is hence questionable, demanding institutional protection for sustainability goals in the long run.

Table 4: Mean ESG scores by year

year	ESG score
2018	66.6786832
2019	66.0170549
2020	61.8917679
2021	56.3723159
2022	53.98115
2023	52.054637

Table 5: MANOVA statistics for ESG by sector

Statistic	value
WilksLambda	0.199
PillaiTrace	1.2083
LawleyTrace	2.2622
RoysLargestRoot	1.1839

Table 6 presents more evidence of this trend, showing the panel regression models' negative and statistically significant year-fixed effects post-2020. To illustrate, the 2020–2023 coefficients are all significant at the 1% level, ranging from –4.77 to –14.33. This means that the drop in ESG score is not random; it is a rather systematic and statistically robust phenomenon.

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Table 6: Baseline fixed-effects (FE) and random-effects (RE) panel regressions for ESG

Variable	FE(1)	RE(2)
Log total assets	1.258	-2.682
Leverage (total liabilities / total assets)	7.145	6.527
Board Size	0.382	0.254
Board Attendance	0.833	0.996
YEAR=2019	-0.779	-0.801
YEAR=2020	-4.765***	-4.840***
YEAR=2021	-10.161***	-10.370***
YEAR=2022	-12.536***	-12.873***
YEAR=2023	-14.326***	-14.846***
Constant	30.714	119.703***
Observations	216	216
Within R2	0.542	0.536
Between R2	0.034	0.188
Overall R2	0.139	0.305

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.4 Multivariate Sectoral Differences

Despite indicating variations in overall ESG scores, the ANOVA fails to consider the multidimensional aspect of ESG performance. Hence, the study conducts a multivariate analysis of variance (MANOVA) where the environmental, social, and governance scores are treated as dependent variables. Fuller insight of the effects of sectoral affiliation on ESG performance is hence derived.

Table 7 presents the highly significant results for the four multivariate tests namely Wilks' Lambda, Pillai's Trace, Lawley–Hotelling Trace, and Roy's Largest Root. The Wilks' Lambda is 0.1990 ($F = 10.19$, $p < 0.001$), denoting significant variations in the E, S, and G scores' distribution. The Pillai's Trace of 1.2083 and Roy's Largest Root of 1.1839 confirm these findings.

H1 is hence further supported, validating both the sector-specific and varied nature of ESG performance. This means that although some sectors are great at governance, they also show poor environmental performance. Others may be driven more by social initiatives. Such multidimensional insight helps in developing targeted ESG policies and, for investors, in evaluating sector-specific sustainability risks and prospects.

Table 7: Fixed-effects regression: female representation and ESG

Variable	Coefficient
Board gender diversity (share of women)	-0.467
Log total assets	1.267
Leverage (total liabilities / total assets)	7.159
Board Size	0.385
Board Attendance	0.824
YEAR=2019	-0.794
YEAR=2020	-4.783***
YEAR=2021	-10.178***
YEAR=2022	-12.562***
YEAR=2023	-14.374***
Constant	30.638
Observations	216
Within R2	0.542
Between R2	0.036
Overall R2	0.137

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.5 Baseline Panel Regression Results

Table 6 presents the baseline regression models' estimation of ESG performance factors using the fixed-effects (FE) and random-effects (RE) methods. Controlling for unobserved firm-level heterogeneity, the FE model explains 54.2% of the ESG score variance within-firms, indicating the major effect of temporal factors. The RE model meanwhile explains 30.5% of the total variation, indicating within and between-firm effects.

Surprisingly, firm size, leverage, board size, and board attendance, i.e., all the firm-level controls, do not show statistical significance in both models. This means that governance and financial factors do not explain the evolution of ESG performance.

The Hausman test is performed to determine the best model for the study; a chi-square statistic of 3.84 ($p = 0.4287$) is derived. The non-significant effect reflects the statistical consistency of the RE estimator. But the FE model is still the best method as it can control time-invariant firm-specific effects that are critical in ESG studies.

5.6 Female Board Representation and ESG Performance

Table 8 presents the results of the fixed-effects model regarding the direct relationship between female board representation and ESG performance. As the coefficient is –0.47 with a p-value of 0.95, no statistically significant link is established. In fact, the effect is negligible.

Hence, H3 is rejected, finding no positive link between female directors and ESG performance. This means that even with female directors on board, sustainability outcomes would not necessarily be positive without taking into account institutional or organizational factors. Past studies have also highlighted the importance of board dynamics, voice, and influence in this matter (Terjesen et al., 2016; Zahid et al., 2022).

Table 8: Sector–female interaction effects on ESG

Variable	Coefficient
Board gender diversity (share of women)	-77.667***
Agriculture x Female	65.303*
Construction x Female	76.539***
Health Care x Female	32.275
Information x Female	63.185**
Manufacturing x Female	125.147***
Mining/ Quarrying x Female	94.111
Retail Trade x Female	53.940**
Transportation and Warehousing x Female	78.765**
Utilities x Female	41.033*
Wholesale Trade x Female	53.940**

Log total assets	-1.492
Leverage	7.725
Board Size	0.269
Board Attendance	0.756
YEAR=2019	-0.855
YEAR=2020	-4.667***
YEAR=2021	-9.758***
YEAR=2022	-12.262***
YEAR=2023	-14.794***
Constant	91.291
N	216
Within R2	0.580
Between R2	0.114
Overall R2	0.238

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.7 Moderation Effects: Sector × Female Interaction

To examine the sectoral link to female board representation, Table 7 presents the interaction terms between board gender diversity and industry dummies. The coefficient for female representation is significantly negative (–77.67, p = 0.002), denoting the base effect in the reference sector omitted.

But certain interaction terms show positive and statistically significant effects, meaning that female board representation can improve ESG performance in certain sectors. The interaction effect in Manufacturing, for instance, is +125.15 ($p < 0.001$) whilst in Construction, it is +76.54 ($p = 0.005$). Information, Retail, and Transportation also demonstrate significant interaction effects.

H4 is hence strongly supported, validating the moderating effect of sectoral factors in the link between female board representation and ESG performance. Female directors in sectors subjected to high stakeholder scrutiny or ESG salience may be able to influence sustainability agendas more significantly. Alternative approaches to board diversity are hence called for, as ESG outcomes are proven to be influenced by structural and cultural determinants.

5.8 ESG Pillar-Specific Regression Results

Table 9 groups the ESG scores into Environmental, Social, and Governance components, estimating the fixed-effects regressions for each separately. Board gender diversity continues to show statistically insignificant coefficients in all three components, reinforcing the non-direct link between female representation and ESG outcomes. The rejection of H3 is again emphasized here, irrespective of the ESG measurement approach.

But the year-fixed effects in these pillar-specific models are consistent with the broader trend apparent in the overall ESG scores. All three components show significant score drops post-2020. The temporal effects are systemic, influencing sustainability as a whole.

Table 9: Fixed-effects regressions for ESG pillars

Variable	Environmental	Social	Governance
Board gender diversity (share of women)	-3.200	5.793	0.484
Log total assets	1.467	1.706	1.539
Leverage (total liabilities / total assets)	6.651	3.709	11.298
Board Size	0.620	-0.563	1.394
Board Attendance	1.162	-0.351	2.075
YEAR=2019	-2.099	-0.974	1.131
YEAR=2020	-3.552**	-4.005*	-7.009**
YEAR=2021	-8.340***	-7.914***	-14.863***
YEAR=2022	-11.252***	-9.653***	-17.431***
YEAR=2023	-14.889***	-11.723***	-17.589***
Constant	17.851	33.483	14.068
Observations	216	216	216
Within R2	0.376	0.322	0.436
Between R2	0.035	0.009	0.034
Overall R2	0.037	0.073	0.106

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 Discussion

The findings critically explain Environmental, Social, and Governance (ESG) performance and the interactions between the individual dimensions amongst publicly listed Malaysian firms. Sectoral, temporal, and board governance factors are shown to be intricately intertwined, indicating the entrenched nature of ESG in institutions and organizations. Further theoretical examinations and empirical comparisons are feasible owing to these findings.

The first key finding, i.e., major sectoral variations in ESG performance is very much aligned with the Institutional Theory that organizational behavior is determined by sectoral norms, regulations, and stakeholder demands (DiMaggio & Powell, 1983). The construction, manufacturing, and healthcare sectors continue to top the ESG performance of others, an indication that highly scrutinized or regulated sectors tend to adopt ESG practices more. Ioannou and Serafeim (2015) agree with this notion, stating that institutions with greater stakeholder salience lean more towards sustainability agendas. Kamaludin et al. (2022) likewise confirmed the role of sectoral affiliation in shaping ESG initiatives, especially those that are heavily monitored for their environmental or labor efforts. The current study adds that sectoral effects are also multidimensional, affecting the environmental, social, and governance dimensions differently. The MANOVA analysis confirms this assertion, suggesting that ESG must be treated as an amalgamation of interconnected but discrete domains.

The second finding reveals the consistent and statistically significant drop in ESG performance post-2020. Global trends in developed markets show otherwise, i.e., upward trajectories in ESG performance (Eccles et al., 2014; Kotsantonis et al., 2016). In Malaysia, this finding reflects a cutback in sustainability efforts due to macroeconomic and crisis conditions like COVID-19. This phenomenon is explained by the Resource Dependence Theory (Pfeffer & Salancik, 1978). Firms that are faced by resource setbacks would put their financial survival ahead of ESG agendas. The lower ESG scores in all three dimensions during the studied period confirms this theory, denoting the optional treatment of sustainability agendas. Due to this, voluntary ESG adoption becomes questionable. Stronger institutional support is needed, including mandatory disclosures and ESG-related financial incentives, so that firms can stay afloat during situations of economic uncertainty. Ullah et al. (2023) observed a similar phenomenon in other emerging economies during systemic crises.

The effect of gender diversity on corporate boards appears to be more complex than often assumed. Overall, there is no significant direct link found between female board representation and ESG performance when the data are examined as a whole. This finding opposes expectations drawn from the stakeholder and agency theories. Bear et al. (2010) and Post et al.

(2011) argued that the presence of women on boards strengthens ethical oversight and improves engagement with stakeholders. But the lack of a consistent effect in this present study suggests that board diversity alone does not automatically lead to better ESG outcomes. Instead, the relationship is hinted to be context-dependent. Female board representation is positively linked to ESG performance in manufacturing, construction, and information services sectors, highlighting the importance of the contingency theory in explaining when and how gender diversity matters (Donaldson, 2001). This theory asserts that the effectiveness of governance mechanisms depends majorly on context, as organizational arrangements must fit the surrounding environment in order to deliver optimal results. The critical mass theory (Kanter, 1977) also suggests that meaningful change is more likely to occur after a certain level of female representation is reached. In industries where ESG issues are particularly salient, or where women are more actively integrated into board decision-making, their presence appears to have a stronger influence. Female representation in sectors characterized by rigid hierarchies or weaker stakeholder pressure, in contrast, may have a non-significant effect. As per Zahid et al. (2022) and Agustina and Barokah (2024), this finding emphasize that gender diversity must be reinforced by institutional legitimacy and genuinely inclusive board practices to produce measurable outcomes.

As a whole, the findings although mixed, fit well with the existing theory. The noticeable differences in ESG performance across sectors, and the tendency for sustainability efforts to slow down during times of crisis, point strongly towards institutional issues. The resource dependence theory helps make sense of the drop in ESG scores in the face of resource constraints and shifting managerial priorities. The contingency theory and critical mass theory also offer useful insights into the inconsistent effects of gender diversity across contexts. Improving governance is hence not just a matter of who sits on the board; it also concerns institutional and sectoral factors that determine how much influence the directors can realistically have.

The findings have clear implications for both scholars and practitioners. They add to the ESG literature in emerging markets by looking at gradual changes and differences across sectors, rather than treating governance and sustainability as uniform phenomena. The methodological choices also matter, as the use of interaction effects and multivariate analysis allows for a more detailed understanding of relationships that would otherwise be difficult to capture using simpler models. On the practical side, the results suggest that ESG policies work best when they are tailored rather than broadly applied. Regulators and investors need to be mindful of sector-specific conditions, the fact that ESG progress can be easily set back by economic disruptions, and the reality that gender diversity only makes a difference when women are

genuinely empowered within governance structures. In Malaysia, future reforms may be more effective with stronger institutional support for ESG and more inclusive boardroom cultures, where diverse voices can actually shape sustainability priorities.

7 Conclusion and Implications

This study looked at what drives ESG performance in Malaysia, focusing on differences across sectors, changes over time, and the impact of gender diversity on corporate boards. Several hypotheses were tested to see whether ESG outcomes vary by industry, decline over time, and respond to the presence of female directors. ESG performance is found to be very sector-specific. Manufacturing, construction, and healthcare sectors especially tend to perform well, while agriculture and utilities lag behind. From 2018 to 2023, ESG scores dropped noticeably, hinting that sustainability efforts in Malaysia are vulnerable to economic and institutional pressures. Gender diversity on boards shows no consistent effect overall, but it matters in certain sectors, showing that the influence of female directors depends on the industry and its specific context.

These findings crucially contribute to research on ESG, gender diversity, and corporate governance in Malaysia. First of all, the study adds depth to ESG research in emerging markets by looking at firm-level data over time and breaking ESG down into its environmental, social, and governance parts. Secondly, it adds to the literature on gender diversity by showing that simply having women on boards does not automatically lead to better outcomes. Instead, the effects depend on context and industry. Thirdly, it advances thinking about corporate governance in Malaysia by showing that board characteristics work within larger institutional and sector-specific environments, highlighting that governance is shaped by the industries and settings in which companies operate.

These findings have clear implications for policymakers, notably Bursa Malaysia and financial regulators. The differences across sectors suggest that ESG rules and sustainability frameworks shouldn’t take a one-size-fits-all approach. Instead, policies should reflect the unique needs of each industry. Regulators could introduce sector-specific benchmarks and incentives, especially for industries that are lagging or don’t face strong pressure to improve on their own. The gradual drop in ESG scores also highlights the need for stronger, more resilient ESG policies. Bursa Malaysia and related institutions might consider making ESG disclosures mandatory, integrating sustainability metrics into corporate reporting, and giving financial or reputational rewards to encourage companies to maintain their ESG efforts, even during economic slowdowns.

For investors, the study shows that understanding ESG risks and opportunities requires looking beyond simple ratings. ESG scores can't be interpreted in isolation; they need to be considered alongside a company's industry and the makeup of its board. The way gender diversity interacts with sectoral dynamics suggests that governance signals matter more in some industries than others. For investors wanting to factor ESG into their portfolios, this means taking a more detailed, context-aware approach, looking at both the company itself and the environment it operates in.

Theoretically, the study supports and adds nuance to several key frameworks. The institutional theory is reinforced by the clear differences in ESG performance across sectors, showing how external pressures shape organizational behavior. The resource dependence theory explains why sustainability efforts tend to drop, especially after economic shocks. The results on gender diversity fit well with the contingency theory, highlighting that governance works depending on context. The critical mass theory also helps make sense of these findings, showing that meaningful representation, and not just token presence, is what drives real impact.

Practically, the findings can serve as a guide for companies, policymakers, and investors. For companies, ESG performance depends not just on internal policies, but also on the industry they operate in, stakeholder demands, and governance structures. This means firms should tailor ESG assessments to their sector and make sure board diversity initiatives come with real influence, not just token representation. For policymakers, including Bursa Malaysia, a one-size-fits-all approach won't work. They should strengthen ESG disclosure rules while also helping underperforming sectors through support and incentives. For investors, the takeaway is to take a more nuanced approach: consider governance, industry context, and trends over time to get a clearer picture of a company's ESG performance.

This study has some limitations. The analysis relies on available ESG data, which may not capture all aspects of sustainability, especially in sectors where companies disclose very little. While the quantitative methods are strong, they might miss important qualitative factors, like boardroom culture and internal governance dynamics, that also affect ESG outcomes. Finally, the findings may not apply outside Malaysia due to the country's regulatory, cultural, and economic distinctness.

Future works could build on this study in several ways. Qualitative case studies could help explain the "why" behind the patterns observed, especially how gender diversity affects ESG outcomes in different contexts. Extending the analysis beyond 2023 could shed light on the post-pandemic recovery and whether the drop in ESG performance is temporary or more lasting. Comparing Malaysia with other ASEAN countries could also show how different

institutional settings influence ESG and governance. Finally, looking at other board characteristics like independence, tenure, or expertise could give a fuller picture of how governance shapes sustainability outcomes.

To sum up, this study shows that ESG performance in Malaysia isn't uniform. In fact, it varies across sectors, changes over time, and depends on governance context. By combining data with theory, the research offers a clearer picture of sustainability in emerging markets and gives firms, regulators, and investors a stronger foundation for developing more targeted and effective ESG strategies.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

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Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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