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-RESEARCH ARTICLE-

SUSTAINABLE FINANCE, OPERATIONAL MANAGEMENT, AND ESG PERFORMANCE IN ASEAN: A PANEL DATA ANALYSIS OF SUSTAINABLE DEVELOPMENT AND ECONOMIC GROWTH

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─Abstract─

Sustainable development has emerged as a central goal in response to the escalating challenges posed by climate change. In this context, the present study investigates how operational management, sustainable finance, and environmental, social and governance (ESG) performance influence sustainable development within ASEAN

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Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

member states over the period from 2000 to 2023. In addition to evaluating the individual effects of these variables, the study further explores their combined influence on sustainable development outcomes. To conduct the empirical analysis, the Driscoll-Kraay Standard Error estimation method is employed, as it offers robustness in addressing cross-sectional dependence within panel data. The empirical findings reveal that operational management, ESG performance, and sustainable finance each contribute positively to sustainable development. Furthermore, the moderating role of ESG performance is examined, revealing that while it weakens the positive association between operational management and sustainable development, it strengthens the positive linkage between sustainable finance and sustainable development across the ASEAN region. These results offer valuable insights for policymakers, suggesting that advancing sustainable finance and effective operational management strategies may serve as key mechanisms for promoting sustainable development within the selected countries.

Keywords: Sustainable Development; Sustainable Finance; Operational Management; ESG; ASEAN.

INTRODUCTION

The increasing deterioration in environmental quality has brought sustainable development (SD) to the forefront of academic inquiry in recent years. Economic sustainability pertains to maintaining a stable and continuous system of industrial and agricultural production. Environmental sustainability reflects the preservation of ecological systems by limiting the excessive use of non-renewable resources and ensuring the stability of ecosystems, biodiversity, and atmospheric conditions. Social sustainability involves fostering a robust social structure that guarantees essential services such as healthcare, quality education, and lifelong learning opportunities (Ilic et al., 2022).

Among various determinants, the literature highlights finance as a pivotal factor in attaining SD. However, traditional financial systems are considered inadequate in addressing SD comprehensively, as they often neglect its environmental and social components. In contrast, sustainable finance (SF) has emerged as a transformative financial model that integrates environmental, social, and governance (ESG) considerations into financial decisions. SF comprises diverse financial instruments and strategies aimed at mitigating social inequalities and environmental harm (Wang et al., 2022; Ziolo et al., 2021). It contributes to the achievement of SD targets by enhancing financial system stability through risk identification and mitigation, promoting technological innovation, and directing capital towards sustainable initiatives. SF further supports financial institutions and businesses in complying with regulatory demands, improves their reputational standing, and addresses key societal challenges,

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

thereby advancing social development. Its global influence continues to grow as environmental and social priorities gain increasing international recognition (Ziolo et al., 2021).

Similarly, operational management (OM) has gained strategic importance for organisations seeking to enhance both sustainability and operational efficiency. OM is defined as the process of designing, operating, and refining systems responsible for delivering primary goods and services (Chase et al., 2006). It involves the administration of physical resources essential for production, often engaging the largest workforce segment and commanding a substantial share of organisational expenditure. Given the contemporary emphasis on environmental protection and climate concerns, managing these systems sustainably has become imperative (Corbett, 2009). Enterprises are now expected to embed environmental and social accountability into their OM practices, ensuring that operational changes or innovations yield economic returns while reducing environmental impacts. In this respect, OM has evolved into a strategic tool for generating sustainable value. Sustainable OM practices empower firms to respond to growing consumer expectations and attain market leadership by aligning product innovation, quality, and sustainability. This comprehensive approach allows firms to realise long-term sustainable growth while contributing meaningfully to environmental protection and societal wellbeing (Wibowo, 2023).

In alignment with this, the United Nations' 2030 Agenda outlines Sustainable Development Goals (SDGs), all of which are interconnected and rest upon social, economic, and governance performance (Zhao et al., 2021). ESG represents a set of standards that assess the environmental, social, and corporate governance dimensions of business operations. It evaluates the ethical and responsible conduct of firms regarding environmental conservation, economic advancement, and social equity. Additionally, it serves as a measure of the effectiveness of policies implemented in these areas (Sadiq et al., 2023). As ESG principles gain international traction, companies across the globe are increasingly adopting sustainability practices grounded in ESG frameworks (Ng et al., 2020). At the macroeconomic level, improvements in ESG performance have been shown to significantly enhance a country's progress toward SD (Chipalkatti et al., 2021).

Given this context, the present study aims to examine the influence of SF, OM, and ESG on SD across four ASEAN nations—Malaysia, the Philippines, Thailand, and Indonesia—spanning the years 2000 to 2023. These countries were selected due to their importance within the ASEAN economic bloc, which is anticipated to experience significant future growth. Since 2000, ASEAN economies have maintained an average growth rate of 5.2 percent. As a result, they have played a prominent role in driving global economic expansion (Nathaniel & Khan, 2020). However, this rapid economic and financial development has contributed to considerable environmental degradation. Collectively, ASEAN nations have been responsible for emitting approximately 13.986

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

billion tonnes of carbon dioxide, accounting for around 41.83 percent of global emissions, with projections suggesting even higher figures in the future (Lin, 2024). Figure 1 illustrates the trend in CO_2 emissions across ASEAN countries during the 2000 to 2023 period.

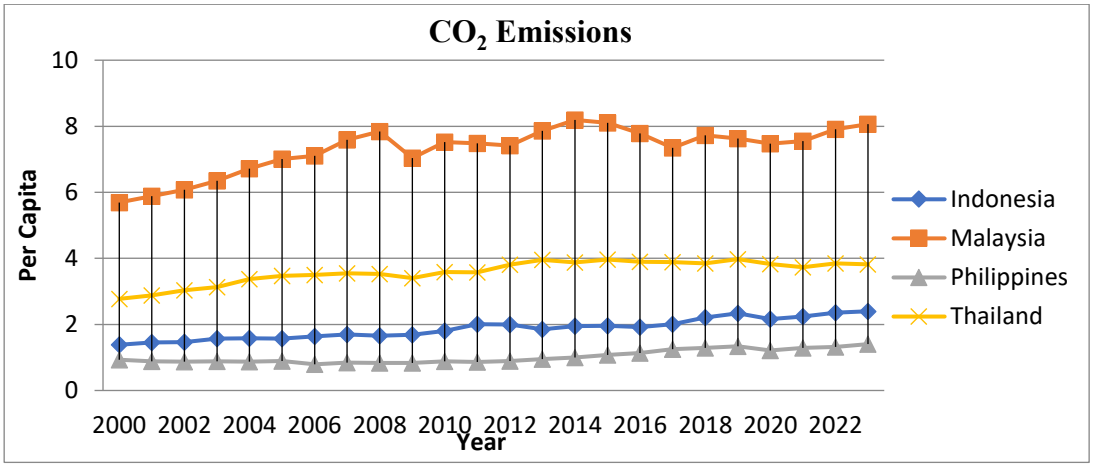

Figure 1: Trend in CO2 Emissions in ASEAN countries

By addressing these objectives, the present research makes several notable contributions to the existing body of work on SD. Firstly, it investigates the influence of OM, SF, and ESG on SD specifically within the ASEAN region, an area that has received relatively limited scholarly focus. Secondly, while previous studies have predominantly concentrated on evaluating the individual effects of these variables, this study advances the discourse by exploring both their direct and combined impacts on SD. This integrated analytical framework offers valuable insights that can support governments in formulating comprehensive strategies for SD, incorporating governance, environmental, and social elements alongside SF and OM initiatives. The study seeks to address the following specific research questions:

1. How does SF influence SD?
2. To what extent does OM affect SD?
3. What is the role of ESG in shaping SD?
4. How does ESG moderate the relationship between SF and SD, and between OM and SD?

The structure of this paper is organised as follows. Section 2 reviews the pertinent literature. Section 3 details the conceptual model, data sources, and research methodology. Section 4 presents the empirical results accompanied by a discussion of the findings. Section 5 concludes the study by offering policy implications and acknowledging its limitations.

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

REVIEW OF EXISTING LITERATURE

This section is organised into two sub-sections. Section 2.1 outlines the theoretical framework, explaining the conceptual links between the selected variables and SD. Section 2.2 presents a review of empirical literature and develops the study's hypotheses based on prior findings.

Theoretical Framework

To explore the connection between OM and SD, this study draws upon the Resource-Based View (RBV) theory. RBV has been extensively applied in OM scholarship to address various dimensions such as supply chain integration, flexibility, capability, and sustainability (Chahal et al., 2020). According to RBV, firms can enhance performance by deploying their internal resources effectively. In particular, those resources and capabilities that are valuable, rare, and difficult to replicate are regarded as the foundation for achieving competitive advantage (Barney, 1991). Hart (1995) later expanded RBV into the natural RBV by incorporating environmental aspects, positing that firms can attain competitive superiority by cultivating capabilities and OM practices aligned with ecological sustainability (Sancha et al., 2023). In this context, strong ESG performance reflects the kind of strategic capabilities described by RBV, as it facilitates the adoption of sustainable practices that can lead to enduring competitive advantages (Whitelock, 2015). In parallel, institutional theory asserts that changes within governance structures and institutions can influence the broader economic, cultural, and social environment, thereby fostering progress toward sustainability (Alwakid et al., 2021). Additionally, the Upper Echelons Theory, introduced by Hambrick and Mason (1984), provides further insight into the relationship between governance and OM outcomes. This theoretical perspective contends that a firm's governance policies, including those related to leadership diversity, executive compensation, and ethical standards, significantly shape organisational functions (Sancha et al., 2023).

Review of Empirical Studies and Hypothesis Development

Both emerging and advanced economies are increasingly prioritising SD in their efforts to achieve sustained economic growth by the year 2030. In this context, various national experiences highlight the significance of SF, OM, and ESG performance as key factors influencing SD. These elements are essential considerations for industries, governments, and corporate entities aiming to realise meaningful progress (Phan, 2024).

Sustainable Finance and Sustainable Development

Given that avenues such as green investment and SF contribute positively to climate-related outcomes, scholarly interest in examining the connection between SF and SD has grown notably, employing a range of metrics and methodologies. For example,

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

using data from European nations, Ziolo et al. (2021) assessed how SF relates to the achievement of SDGs and concluded that SF plays a significant role in advancing these goals. At the global level, Wang et al. (2022) explored the causal dynamics between green finance and SD through a bootstrapped rolling-window Granger causality technique, finding that green finance exerts a favourable influence on SD. In the context of the Baltic Sea region, Streimikiene et al. (2023) demonstrated that SF has enhanced SD outcomes within these countries. Similarly, focusing on China from 1990 to 2020, Xiong and Dai (2023) employed the System GMM method to show that green finance investments have promoted SD. Additionally, Wang et al. (2022) investigated the contribution of green finance to SD across developing nations over the 2000–2020 period, also using the System GMM approach. Drawing from these empirical insights, the study proposes the following hypothesis concerning the relationship between SF and SD,

H1: *SF is significantly related to SD.*

Operational Management and Sustainable Development

In contrast, limited empirical research has examined the link between OM and SD. Corbett (2009) introduced a classification framework for OM based on the three pillars of CSR and the stages within a product's life cycle. This framework was applied in the context of industrial ecology and carbon neutrality, leading to a set of propositions aimed at addressing carbon-related challenges. In a regional study, Yu et al. (2021) explored the association between green logistics and environmental degradation across Asian economies. Using the GMM estimation technique, their analysis showed that environmentally conscious supply chain practices significantly mitigated the adverse environmental effects of logistics operations. Furthermore, Albloushi et al. (2023) investigated how total quality management contributes to corporate SD in manufacturing enterprises, with green innovation as a mediating factor. Their findings suggested that quality management practices strengthened SD performance. Similarly, Holloway (2024) evaluated the influence of sustainable inventory strategies on supply chain efficiency, concluding that inventory investment positively influenced brand perception and operational effectiveness. Based on these findings, the second hypothesis regarding the relationship between OM and SD is formulated as follows,

H2: *Operational Management is significantly related with SD.*

ESG Performance and Sustainable Development

The association between ESG and SD has been receiving growing scholarly interest, particularly in relation to firm-level performance. For example, Zhang and Jin (2022) explored how ESG factors influence corporate green innovation in China during the 2015 to 2019 period. Their analysis, based on the Fixed Effects model, revealed that ESG dimensions enhanced firms' capacity for green innovation. In another ASEAN-

focused study, Wibawa and Septianto (2024) assessed the interplay between ESG, economic growth, and SD through panel ARDL regression, concluding that ESG elements significantly advanced SD in these nations. Additionally, Işık et al. (2024) investigated the ESG-economic growth linkage across South Asia and East Asia and Pacific countries using FMOLS and DOLS techniques. The results suggested heterogeneity in outcomes, as governance-related aspects influenced economic growth only in developing countries, with no notable impact observed in developed ones. Furthermore, Jamal et al. (2022) assessed the contribution of ESG to sustainable performance within China's financial sector. Employing the GMM approach, the study found that only environmental aspects positively influenced firms' sustainable performance. In light of this body of evidence, the third hypothesis concerning the relationship between ESG and SD is formulated as follows,

H2: *ESG is significantly related to SD.*

ESG Performance, Operational Management and Sustainable Finance

In contrast to the previously discussed literature, the interconnectedness of ESG factors with sustainable finance and OM has received comparatively limited attention. For instance, Ramadhani (2019) explored the relationship between the ESG landscape and the financial trajectory of ASEAN nations. The findings demonstrated that ESG-driven financial policies facilitate sustainable investment inflows, enhance economic resilience, and reduce climate-related financial vulnerabilities. Gao et al. (2024) investigated how green finance influences ESG performance among Chinese firms, applying the difference-in-difference methodology for the 2013 to 2020 period. The outcomes confirmed that the adoption of green finance policies significantly strengthened ESG-related practices within firms. Similarly, Kao (2023) evaluated the performance of Taiwan's industrial parks through the lens of ESG and concluded that incorporating ESG considerations into their operational and managerial frameworks is essential. Additionally, Xu and Wan (2024) examined the connection between operational efficiency and ESG, reporting that existing studies reflect inconsistent findings across different contexts and sectors. Drawing from these studies, the fourth hypothesis concerning the interaction between ESG, sustainable finance, and OM is proposed as follows,

H4: *ESG performance significantly moderates the relationship of SF and OM with SD.*

Literature Gap

The preceding review suggests that while several studies have explored the association between sustainable finance and sustainable development, the contribution of operational management to sustainable development has not been examined in comparable depth. To the best of the authors' knowledge, the moderating influence of ESG performance on the links between sustainable finance and sustainable

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

development, and between operational management and sustainable development, has not yet been investigated. Accordingly, the present study seeks to address these critical research gaps by examining the influence of sustainable finance and operational management on sustainable development, incorporating ESG performance as a moderating variable in the context of ASEAN countries. In doing so, the study offers a distinct and original contribution to the ongoing discourse on sustainable development.

DATA AND METHODOLOGY

Model of the Study

In alignment with the objective of identifying the primary determinants of sustainable development within ASEAN countries, the study formulates sustainable development as a linear function of operational management, sustainable finance, and ESG performance, grounded within the theoretical framework of the Resource-Based View.

$$\mathrm{SD_{it}} = \beta_0 + \beta_1 \mathrm{SF_{it}} + \beta_2 \mathrm{OM_{it}} + \beta_3 \mathrm{ESG_{it}} + \varepsilon_{it} \quad (1)$$

Additionally, to assess the combined influence of ESG performance, operational management, and sustainable finance, ESG is introduced into the model as a moderating variable, thereby resulting in the following extended specification:

$$\mathrm{SD_{it}} = \beta_0 + \beta_1 \mathrm{SF_{it}} + \beta_2 \mathrm{OM_{it}} + \beta_3 \mathrm{ESG_{it}} + \beta_4 \mathrm{SF} * \mathrm{ESG_{it}} + \beta_4 \mathrm{OM} * \mathrm{ESG_{it}} + \varepsilon_{it} \quad (2)$$

Moreover, consistent with the methodologies adopted by (Chen et al., 2022) and (Satterthwaite & Bartlett, 2016), urbanisation (URB) is incorporated as a control variable to mitigate potential model misspecification. Accordingly, the final model is specified as follows:

$$SD_{it} = \beta_0 + \beta_1 SF_{it} + \beta_2 OM_{it} + \beta_3 ESG_{it} + \beta_4 SF * ESG_{it} + \beta_4 OM * ESG_{it} + \beta_5 URB_{it} + \varepsilon_{it} \quad (3)$$

Data

For empirical investigation, the study utilises annual data covering the period from 2000 to 2023 for four ASEAN countries. Comprehensive information regarding the variables employed in the analysis is presented in Table 1.

Table 1: Variables of the Study and Data Sources

Variables	Acronym	Measurement	Data Source
Sustainable Development	SD	Sustainable Development Index	Sustainable Development index.org
Operational Management	OM	Total Factor Productivity	Our World in Data

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

Sustainable Finance	SF	International Financial Flows to Developing Countries for Renewable Energy R&D and Renewable Energy Production	Our World in Data
Environmental, Governance and Social Performance	ESG	Index Comprising of CO_2 Emissions, Government Effectiveness, GDP Growth, Unemployment Rate and Labour Force Participation Rate	World Development Indicators
Urbanization	URB	Urban Population (% of total population)	World Development Indicators

Method of Estimation

Test of Cross-Sectional Dependence (CSD)

The initial step in panel data analysis involves testing for CSD, as it forms the basis for subsequent empirical procedures. CSD may arise due to a variety of factors, including both observed and unobserved common shocks, as well as residual interdependencies across units. Failure to account for such spillover effects among cross-sectional units can result in biased, inconsistent, and misleading estimators. Consequently, it is essential to assess the presence of CSD at the outset of the panel data analysis. For this purpose, the present study employs the Hashem Pesaran & Yamagata, (2008) test. The corresponding equation is specified as follows:

$$CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}\right) \sim N(0,1) i,j \quad (4)$$

Where, N and T show time and cross sections, respectively and $\hat{\rho}_{ij}$ represent parameter of pairwise correlation.

Test of Slope Heterogeneity

Secondly, this study assesses the consistency of slope coefficients by employing the slope heterogeneity test developed by (Hashem Pesaran & Yamagata, 2008). This test is regarded as robust when cross-sectional dependence is present. The corresponding test statistics are reported as follows:

$$\tilde{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S}-k}{\sqrt{2k}}\right) \quad (5)$$

$$\tilde{\Delta}_{adj} = \frac{\sqrt{N}\left[N^{-1}\tilde{S}-E(\tilde{Z}_{it})\right]}{\sqrt{Var(\tilde{Z}_{it})}} \quad (6)$$

In equation (5) and (6), $\tilde{\Delta}$ and $\tilde{\Delta}_{adj}$ show delta tilde and adjusted delta tilde, respectively.

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

Tests of Unit Root

Due to cross-sectional dependence and slope heterogeneity, first-generation unit root tests may produce biased results. Therefore, second-generation tests like CIPS and CADF (Hashem Pesaran & Yamagata, 2008) are recommended. The CADF test is formulated as follows:

$$\Delta y_{it} = \alpha_i + \rho_i^* y_{it-1} + d_0 \bar{y}_{t-1} + \sum_{j=0}^{p} d_{j+1} \overline{\Delta y}_{t-j} + \sum_{k=1}^{p} c_k \Delta y_{it-k} + \varepsilon_{it} \qquad (7)$$

This statistic facilitates the computation of the CIPS test value, which is expressed as follows:

$$CIPS = \frac{1}{N} \sum_{i=1}^{N} CADF_i \qquad (8)$$

Regression Analysis using Driscoll-Kraay Standard Error Approach

The present study investigates the long-run relationship between the selected independent variables and the dependent variable by employing the Driscoll-Kraay Standard Error (DK-SE) estimation technique. This approach is particularly suitable for handling CSD and slope heterogeneity, both of which are identified in the dataset. Unlike conventional estimation methods, the DK-SE technique accounts for cross-sectional correlations among panel units, thereby delivering robust and efficient parameter estimates under such conditions (Ridwan et al., 2024). Given the confirmed presence of slope heterogeneity and CSD, the DK-SE method is deemed appropriate for the analysis. The procedural steps of the regression analysis are illustrated in Figure 2.

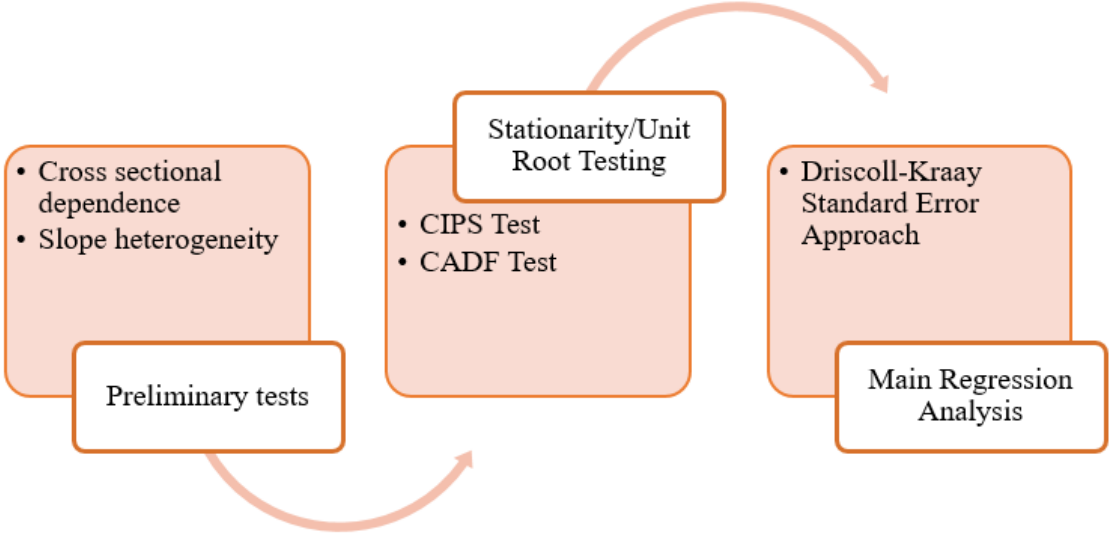

Figure 2: Scheme of Applied Method for Analysis

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

RESULTS AND DISCUSSION

The descriptive statistics are summarised in Table 2. Among the variables, URB displays the highest mean, while ESG reflects the lowest. This pattern is also evident in the standard deviation, where URB shows the greatest dispersion and ESG the smallest. The SD indicator ranges from a minimum of 0.554 to a maximum of 0.813. SF values extend from 0.000 to 1.140, while OM ranges between 0.689 and 1.031. For ESG, the values span from -1.674 to 1.789. The URB variable ranges between 31.386 and 78.716. Moreover, the correlation matrix outlining the relationship between the dependent and explanatory variables is presented in Table 3.

Table 2: Results of Descriptive Statistics

Variables	Mean	Standard Deviation	Minimum Value	Maximum Value
SD	0.725	0.0539	0.554	0.813
SF	1.030	2.070	0.000	1.140
OM	0.891	0.0838	0.689	1.031
ESG	-5.431	1.000	-1.674	1.789
URB	53.016	11.958	31.386	78.716

The findings reveal that only OM and ESG exhibit a statistically significant association with SD. Specifically, OM is positively correlated with SD, while ESG demonstrates a negative correlation. In contrast, SF and URB do not show any statistically meaningful correlation with SD.

Table 3: Correlation Matrix

Variables	SD	SF	OM	ESG	URB
SD	1.000				
SF	0.159	1.000			
OM	0.060*	0.258	1.000		
ESG	-0.013**	-0.328	0.242	1.000	
URB	-0.376	-0.039	0.598	0.571	1.000

Where, * and ** show significance at 10 and 5 percent, significantly.

Following the descriptive statistics and correlation matrix analysis, the presence of CSD is examined using the test proposed by (Hashem Pesaran & Yamagata, 2008). The test results suggest that the issue of CSD is evident in certain variables within the dataset as shown in Table 4. Alongside this, the study evaluates slope homogeneity.

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

Table 4: Results of CSD Test

Variables	CD-Test	P-Value
SD	0.439	0.661
SF	1.063	0.288
OM	10.456***	0.000
ESG	0.438	0.661
URB	10.272***	0.000

Where, *** indicates significance at 1%.

The outcomes presented in Table 5 indicate that both the delta and adjusted delta tilde statistics are statistically significant. These results lead to the rejection of the null hypothesis, thereby confirming the presence of slope heterogeneity in the panel data.

Table 5: Results of Slope Heterogeneity Test

	Test Statistics	Prob-value
Delta tilde	3.393**	0.001
Adjusted Delta Tilde	4.381***	0.000

Where, *** and ** indicate 1 and 5 percent significance levels.

Due to slope heterogeneity and CSD concerns, second-generation unit root tests (CIPS and CADF) are applied, with results shown in Table 6. The variables display a mixed integration order. The study also explores the effects of SF and OM on SD, moderated by ESG performance, using the DK-SE method, with findings in Table 7.

Table 6: Results of Stationarity Tests

Variables	CIPS		CADF	
	At Level	First Difference	At Level	First Difference
SD	-1.134	-4.357***	-1.269	-4.045***
SF	-4.131***	----------	-3.655***	---------
OM	-0.908	-3.851***	-0.908	-3.851***
ESG	-2.276**	---------	-1.665	-2.987**
URB	-0.029	-4.520***	0.656	-4.520***

Where, *** and ** indicate 1 and 5% significance level, respectively.

Table 7: Findings of Driscoll-Kraay Standard Error Technique

Variables	Coefficients	Driscoll-Kraay Standard Error	t-stat	Prob-value
SF	6.26e-11**	1.69e-11	3.70	0.002
OM	0.1544**	0.0738	2.09	0.050
ESG	0.234***	0.0450	5.20	0.000
OM*ESG	-0.271***	0.0551	-4.93	0.000
SF*ESG	4.33e-11**	1.86e-11	2.32	0.032
URB	-0.0010	0.0013	-0.78	0.444

Where, *** and ** indicate 1 and 5% significance level, respectively.

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

The estimated coefficient for SF is both positive and statistically significant, signifying that SF contributes positively to SD. The magnitude of the coefficient implies that a one-unit increase in SF is associated with a 6.26-unit improvement in SD. Furthermore, green finance provides essential funding for renewable energy sources, which are non-polluting and thus promote sustainability (Zakari, 2022). These results align with the findings of Streimikiene et al. (2023), who observed that SF significantly enhances progress towards SDGs in the Baltic Sea region. Similarly, Wang et al. (2022) demonstrated a positive global relationship between green finance and SD, corroborating the present study's findings. In the same vein, Lee et al. (2022) noted that climate-related financial assistance contributes to reductions in CO_2 emissions.

Additionally, Sancha et al. (2023) substantiate these findings by demonstrating that the implementation of sustainable OM practices leads to improved environmental and social indicators. In terms of ESG performance, the associated coefficient is also positive and statistically significant, underscoring a favourable influence on SD. Specifically, a one-unit increase in ESG is linked with a 0.234-unit improvement in SD. This suggests that effective environmental practices, such as sanitation improvements, waste management, reductions in harmful emissions, and clean energy use, play a vital role in advancing SD objectives. This conclusion is consistent with Sadiq et al. (2023), who documented that ESG performance fosters SD in ASEAN countries. Similarly, the study by Wibawa and Septianto (2024) affirmed that ESG practices facilitate the achievement of SD goals within ASEAN. Furthermore, the findings of (Işık et al., 2024) also point to the positive contribution of environmental, social, and economic indicators to economic growth in South Asia and East Asia Pacific regions. The interaction term SF*ESG is both significant and positive, implying that ESG enhances the beneficial effect of SF on SD. The results indicate that the integration of robust ESG frameworks with SF strengthens the latter's effectiveness in achieving sustainability outcomes. This supports the notion that sound governance structures, when paired with SF, help alleviate environmental damage (Afzal et al., 2022). Although the interactive effect between ESG and SF has not been extensively studied, these findings are somewhat aligned with Du et al. (2023), who reported that energy governance moderates the impact of green finance positively in the context of energy transitions. Similarly, Ramadhani (2019) found that ESG elements can enhance SF in ASEAN economies by drawing in sustainable investments.

Conversely, the interaction term OM*ESG is statistically significant but negative, indicating that ESG weakens the positive association between OM and SD in ASEAN countries. This unexpected outcome may be attributed to the notion that ESG factors have a diminished effect in highly competitive environments, where firms may prioritise immediate profitability over long-term sustainability (Jung & Yoo, 2023). This interpretation is further supported by the findings of Al-Ahdal, Farhan, Al-ahdal et al. (2023), who observed that ESG performance could adversely affect firm outcomes when mediated by executive decisions, particularly in contexts where leadership

Vol: 16 **No:** 04 **Year:** 2024 **ISSN:** 1309-8055 (Online) (**pp.** 339-356) **Doi:** 10.34109/ijefs.202416416

preferences limit sustainable progress, as seen in Indian firms.Finally, the coefficient for URB is found to be statistically insignificant, suggesting that urbanisation does not exert a meaningful effect on SD within the ASEAN context. This result is consistent with the findings of Zhang et al. (2018).

CONCLUSION OF THE STUDY AND POLICY RECOMMENDATIONS

This study explores the nexus between OM, SF, ESG performance, and SD across four ASEAN countries over the period from 2000 to 2023. Distinct from previous literature, which has predominantly examined these variables in isolation, the current research offers a novel contribution by assessing their collective influence, specifically through the moderating role of ESG in the relationship between OM, SF, and SD. By employing a robust panel estimation method capable of addressing issues related to CSD and slope heterogeneity, the findings affirm that OM, SF, and ESG performance each play a significant role in advancing SD within the selected ASEAN economies. Notably, the moderating effect of ESG is twofold: it amplifies the positive association between SF and SD, while it attenuates the beneficial impact of OM on SD.

Considering these findings, several policy recommendations can be proposed. Firstly, given the strong positive influence of SF on SD, it is imperative that governments in these economies prioritise the facilitation of sustainable financing. This can be achieved through the implementation of regulatory frameworks that incentivise green investments, mandate sustainability disclosures, and foster a financing culture oriented towards environmental and social responsibility. Secondly, governments should enhance carbon pricing mechanisms, including cap-and-trade systems, to further promote environmentally sustainable investment behaviours. The provision of green tax benefits and the encouragement of public-private partnerships may also attract increased private capital into green infrastructure and sustainable finance initiatives. Moreover, it is essential for governments to support businesses in adopting ESG-focused practices. This involves offering fiscal or regulatory incentives that encourage firms to integrate ESG criteria into their operations and strategic planning. Strengthening ESG practices within corporate governance can promote more resilient, responsible, and sustainable operational frameworks. In addition, policy measures should support the development of green skills within the workforce. Integrating sustainability-focused education and vocational training into business and industrial sectors will equip human capital with the expertise needed to implement sustainable operational strategies.

The study is not without limitations. Firstly, due to data availability constraints, the analysis was confined to only four ASEAN countries, limiting the generalisability of the findings across the entire region. Secondly, while the study provides valuable insights into the ASEAN context, the extent to which these conclusions apply to developed economies remains uncertain, and future studies should consider cross-

regional comparisons to assess external validity. Another notable limitation is the omission of potential structural breaks and the issue of data non-normality in the empirical analysis. This could introduce inefficiencies in the estimations.

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REFERENCES

Afzal, A., Rasoulinezhad, E., & Malik, Z. (2022). Green finance and sustainable development in Europe. *Economic research-Ekonomska istraživanja*, *35*(1), 5150-5163. https://doi.org/10.1080/1331677X.2021.2024081

Al-ahdal, W. M., Farhan, N. H. S., Vishwakarma, R., & Hashim, H. A. (2023). The moderating role of CEO power on the relationship between environmental, social and governance disclosure and financial performance in emerging market. *Environmental Science and Pollution Research*, *30*(36), 85803-85821. https://doi.org/10.1007/s11356-023-28499-5

Albloushi, B., Alharmoodi, A., Jabeen, F., Mehmood, K., & Farouk, S. (2023). Total quality management practices and corporate sustainable development in manufacturing companies: the mediating role of green innovation. *Management Research Review*, *46*(1), 20-45. https://doi.org/10.1108/MRR-03-2021-0194

Alwakid, W., Aparicio, S., & Urbano, D. (2021). The Influence of Green Entrepreneurship on Sustainable Development in Saudi Arabia: The Role of Formal Institutions. *International Journal of Environmental Research and Public Health*, *18*(10), 5433. https://doi.org/10.3390/ijerph18105433

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99-120. https://doi.org/10.1177/014920639101700108

Chahal, H., Gupta, M., Bhan, N., & Cheng, T. C. E. (2020). Operations management research grounded in the resource-based view: A meta-analysis. *International Journal of Production Economics*, *230*, 107805. https://doi.org/10.1016/j.ijpe.2020.107805

Chase, R. B., Jacobs, F. R., & Aquilano, N. J. (2006). Operations management for competitive advantage. https://library.giadinh.edu.vn/items/575e657d-5f46-4d1b-bbb3-eb7737cfa4c6

Chen, M., Chen, L., Cheng, J., & Yu, J. (2022). Identifying interlinkages between urbanization and Sustainable Development Goals. *Geography and Sustainability*, *3*(4), 339-346. https://doi.org/10.1016/j.geosus.2022.10.001

Chipalkatti, N., Le, Q. V., & Rishi, M. (2021). Sustainability and Society: Do Environmental, Social, and Governance Factors Matter for Foreign Direct Investment? *Energies*, *14*(19). https://doi.org/10.3390/en14196039

Corbett, L. M. (2009). Sustainable operations management: A typological approach. *Journal of Industrial Engineering and Management (JIEM)*, *2*(1), 10-30. https://doi.org/10.3926/jiem.v2n1.p10-30

Du, J., Shen, Z., Song, M., & Vardanyan, M. (2023). The role of green financing in facilitating renewable energy transition in China: Perspectives from energy governance, environmental regulation, and market reforms. *Energy Economics*, *120*, 106595. https://doi.org/10.1016/j.eneco.2023.106595

Gao, D., Zhou, X., & Wan, J. (2024). Unlocking sustainability potential: The impact of green finance reform on corporate ESG performance. *Corporate Social Responsibility and Environmental Management*, *31*(5), 4211-4226. https://doi.org/10.1002/csr.2801

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of management review*, *9*(2), 193-206. https://doi.org/10.5465/amr.1984.4277628

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of management review*, *20*(4), 986-1014. https://doi.org/10.5465/amr.1995.9512280033

Hashim Pesaran, M., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics*, *142*(1), 50-93. https://doi.org/10.1016/j.jeconom.2007.05.010

Holloway, S. (2024). The Role of Inventory Management in Achieving Sustainability in Supply Chains. *Preprints*. https://doi.org/10.20944/preprints202407.1016.v1

Ilic, S., Petrovic, T., & Djukic, G. (2022). Eco-innovation and sustainable development. *Problemy Ekorozwoju*, *17*(2). https://doi.org/10.35784/pe.2022.2.21

Işık, C., Ongan, S., Islam, H., Jabeen, G., & Pinzon, S. (2024). Is economic growth in East Asia pacific and South Asia ESG factors based and aligned growth? *Sustainable Development*, *32*(5), 4455-4468. https://doi.org/10.1002/sd.2910

Jamal, S., Malik, M. F., & Ahmed, W. (2022). Impact of environmental, social and governance (ESG) on firms market performance; evidence from China. *Competitive Social Sciences Research Journal*, *3*(2), 18-31. https://cssrjournal.com/index.php/cssrjournal/article/view/162

Jung, Y. L., & Yoo, H. S. (2023). Environmental, social, and governance activities and firm performance: Global evidence and the moderating effect of market competition. *Corporate Social Responsibility and Environmental Management*, *30*(6), 2830-2839. https://doi.org/10.1002/csr.2518

Kao, L.-L. (2023). ESG-Based Performance Assessment of the Operation and Management of Industrial Parks in Taiwan. *Sustainability*, *15*(2), 1424. https://doi.org/10.3390/su15021424

Lee, C.-C., Li, X., Yu, C.-H., & Zhao, J. (2022). The contribution of climate finance toward environmental sustainability: New global evidence. *Energy Economics*, *111*, 106072. https://doi.org/10.1016/j.eneco.2022.106072

Lin, C. (2024). Asymmetric effects of digitalization, natural resources, capital formation, and green innovations on environmental sustainability in ASEAN

countries. *Resources Policy*, *92*, 104995. https://doi.org/10.1016/j.resourpol.2024.104995

Nathaniel, S., & Khan, S. A. R. (2020). The nexus between urbanization, renewable energy, trade, and ecological footprint in ASEAN countries. *Journal of Cleaner Production*, *272*, 122709. https://doi.org/10.1016/j.jclepro.2020.122709

Ng, T.-H., Lye, C.-T., Chan, K.-H., Lim, Y.-Z., & Lim, Y.-S. (2020). Sustainability in Asia: The Roles of Financial Development in Environmental, Social and Governance (ESG) Performance. *Social Indicators Research*, *150*(1), 17-44. https://doi.org/10.1007/s11205-020-02288-w

Phan, T. C. (2024). Impact of green investments, green economic growth and renewable energy consumption on environmental, social, and governance practices to achieve the sustainable development goals: A sectoral analysis in the ASEAN economies. *International Journal of Engineering Business Management*, *16*, 18479790241231725. https://doi.org/10.1177/18479790241231725

Ramadhani, D. (2019). Understanding environment, social and governance (ESG) factors as path toward ASEAN sustainable finance. *APMBA (Asia Pacific Management and Business Application)*, *7*(3), 147-162. https://doi.org/10.21776/ub.apmba.2019.007.03.2

Ridwan, M., Urbee, A. J., Voumik, L. C., Das, M. K., Rashid, M., & Esquivias, M. A. (2024). Investigating the environmental Kuznets curve hypothesis with urbanization, industrialization, and service sector for six South Asian Countries: Fresh evidence from Driscoll Kraay standard error. *Research in Globalization*, *8*, 100223. https://doi.org/10.1016/j.resglo.2024.100223

Sadiq, M., Ngo, T. Q., Pantamee, A. A., Khudoykulov, K., Ngan, T. T., & Tan, L. P. (2023). The role of environmental social and governance in achieving sustainable development goals: evidence from ASEAN countries. *Economic research-Ekonomska istraživanja*, *36*(1), 170-190. https://doi.org/10.1080/1331677X.2022.2072357

Sancha, C., Gutierrez-Gutierrez, L., Tamayo-Torres, I., & Gimenez Thomsen, C. (2023). From corporate governance to sustainability outcomes: the key role of operations management. *International Journal of Operations & Production Management*, *43*(13), 27-49. https://doi.org/10.1108/IJOPM-01-2022-0043

Satterthwaite, D., & Bartlett, S. (2016). Urbanization, development and the sustainable development goals. In *Cities on a Finite Planet* (pp. 1-16). Routledge. https://doi.org/10.4324/9781315645421-1

Streimikiene, D., Mikalauskiene, A., & Burbaite, G. (2023). The role of sustainable finance in achieving sustainable development goals. *Economics & sociology*, *16*(1), 256-283. https://www.ceeol.com/search/article-detail?id=1169886

Wang, K.-H., Zhao, Y.-X., Jiang, C.-F., & Li, Z.-Z. (2022). Does green finance inspire sustainable development? Evidence from a global perspective. *Economic Analysis and Policy*, *75*, 412-426. https://doi.org/10.1016/j.eap.2022.06.002

Whitelock, V. G. (2015). *Relationship between Environmental Social Governance (ESG) Management and Performance – The Role of Collaboration in the Supply Chain* University of Toledo]. http://rave.ohiolink.edu/etdc/view?acc_num=toledo1450087632

Wibawa, K. D., & Septianto, T. (2024). Unlocking sustainable development: ASEAN ESG and economic growth implication. *Advances in Environmental Innovation*, *1*(2), 176-188. https://doi.org/10.69725/aneva.v1i2.210

Wibowo, I. (2023). Operational Management in the Digital Era: Strategic Integration with Entrepreneurship. *Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)*, *2*(02), 96-102. https://doi.org/10.58471/esaprom.v2i02.4033

Xiong, Y., & Dai, L. (2023). Does green finance investment impact on sustainable development: Role of technological innovation and renewable energy. *Renewable Energy*, *214*, 342-349. https://doi.org/10.1016/j.renene.2023.06.002

Xu, J., & Wan, L. (2024). Research on the Relationship between Operational Efficiency and ESG Performance: A New Perspective for Continued Growth. *Industrial Engineering and Innovation Management*, *7*(1), 176-181. https://doi.org/10.23977/ieim.2024.070123

Yu, Y., Zhu, W., & Tian, Y. (2021). Green supply chain management, environmental degradation, and energy: evidence from Asian countries. *Discrete Dynamics in Nature and Society*, *2021*(1), 5179964. https://doi.org/10.1155/2021/5179964

Zakari, A. (2022). The role of green finance in promoting sustainable economic and environmental development. *Studies of Applied Economics*, *40*(3). https://doi.org/10.25115/eea.v40i3.5398

Zhang, C., & Jin, S. (2022). What Drives Sustainable Development of Enterprises? Focusing on ESG Management and Green Technology Innovation. *Sustainability*, *14*(18), 11695. https://doi.org/10.3390/su141811695

Zhang, G., Zhang, N., & Liao, W. (2018). How do population and land urbanization affect CO2 emissions under gravity center change? A spatial econometric analysis. *Journal of Cleaner Production*, *202*, 510-523. https://doi.org/10.1016/j.jclepro.2018.08.146

Zhao, Z., Liu, Y., Wang, J., Wang, B., & Guo, Y. (2021). Association rules analysis between brand post characteristics and consumer engagement on social media. *Engineering Economics*, *32*(4), 387-403. https://doi.org/10.5755/j01.ee.32.4.28060

Ziolo, M., Bak, I., & Cheba, K. (2021). The role of sustainable finance in achieving sustainable development goals: Does it work? *Technological and Economic Development of Economy*, *27*(1), 45-70. https://doi.org/10.3846/tede.2020.13863