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Abstract: This research examines whether green innovation affects sustainability disclosure and firm value among firms listed on the Indonesia Stock Exchange. Using 438 firm-year observations (2019-2024) from firms that publish sustainability reports, the analysis employs ordinary least squares regressions to test the hypothesis. Applying the Heckman regression to validate the robustness of our findings, the results show a negative impact of green innovation on firm value and sustainability disclosure. This research presents a novel and multidimensional measure of green innovation by incorporating five key components – green processes, green products, green organizational culture, green supply chains, and green marketing – capturing broader organizational commitment beyond patent counts or R&D expenditures. Drawing on signalling and socio-political perspectives, the findings suggest that innovation-driven sustainability initiatives may generate adverse signals in emerging markets when costs are front-loaded, benefits are delayed, and credibility is uncertain. The findings highlight the importance of strategic alignment between innovation and reporting. Managerially, green innovation programmes should be supported by credible reporting and assurance mechanisms, while policymakers can strengthen disclosure infrastructure and incentives to enhance the credibility and comparability of sustainability information.

Abstract: This study addresses the erosion of platform credibility in international e-commerce caused by the misalignment between numerical star ratings and actual textual sentiment. While star ratings are a dominant mechanism guiding purchasing decisions in rapidly expanding markets like Southeast Asia, they are frequently inflated due to platform-induced biases and region-specific cultural factors, such as the politeness norms and indirect communication strategies prevalent in Thai culture. To overcome this structural limitation, this research aims to empirically quantify this discrepancy and introduce a transparent, sentiment-informed metric—the "Heart Score"—to recalibrate ratings. A rule-based sentiment analysis framework specifically adapted for Thai-language reviews was applied to a dataset of 14,877 women's clothing entries from Lazada. By leveraging expert-validated lexicons and linguistic rules for negation and amplification, store-level sentiment ratios were extracted and transformed into recalibrated scores via a normalized linear function with penalty adjustments. Findings confirm substantial sentiment misalignment: although the analyzed stores clustered narrowly with star ratings between 4.92 and 5.00, the recalibrated Heart Scores spanned a significantly wider, more meaningful range of 3.81 to 4.71. The most notable gap of 1.11 points exposed hidden dissatisfaction masked by near-perfect ratings. The proposed framework offers strong managerial insights for platform governance by enhancing review credibility, enabling more accurate product benchmarking, and providing a scalable, interpretable model for restoring trust in low-resource language environments.

Abstract: There has been an increasing amount of research in recent years on the moderating roles of financial market development, institutional quality, financial stability and economic growth on financial inclusion. However, there remains a dearth of research on the Common Market for Eastern and Southern Africa (COMESA) region, compared to other economic blocs like Sub-Saharan Africa (SSA), the Southern African Development Community (SADC), and the Economic Community of West African States (ECOWAS), largely due to data paucity, a lack of interest among active scholars, and the heterogeneity of economies in the region. Yet these differences are further reasons we should engage in scholarly research, which informs practice and policy changes with real-world impact on previously excluded communities. This study investigates the impact of financial stability and economic growth on financial inclusion in the COMESA region, utilising panel data from 2007 to 2022 and employing a two-step system GMM estimation method. Financial inclusion and financial stability in this study are measured using a composite index derived from principal component analysis (PCA). We found that the lag of financial inclusion, financial stability and economic growth exert a positive and significant impact on financial inclusion in the region. Among the considered control variables, the findings revealed that domestic credit to the private sector and the real interest rate both have a positive impact, while mobile subscriptions, institutional quality, and income inequality have a negative impact on financial inclusion in the region. This study recommends that policymakers implement financial market reforms to facilitate greater financial inclusion by lowering the cost of mobile data access and mandating that all state banks establish low-cost bank accounts with savings and transactional capabilities. To increase intra-trade amongst member states, we recommend easing import and export customs and excise duties, as well as similar tariffs, on services rendered by and goods manufactured or produced by MSMEs, in line with the provisions of the African Continental Free Trade Area (AfCFTA) agreement, leading to productive cross-border investments, regional integration, increased trade and economic growth.

Abstract: Taxes are crucial for the country's growth, comprising a significant portion of the state budget. To ensure a fair tax burden and maintain the integrity of the tax system, the Indonesian government must address the issue of tax avoidance. This research paper aims to investigate the relationship between firm profitability, financial leverage, and the moderating impact of the audit committee on tax avoidance practices. This study examines the influence of leverage and profitability on tax avoidance practices within the Indonesian banking industry, focusing on firms listed on the Indonesia Stock Exchange from 2020 to 2022. The researchers also explored the moderating role of the Audit Committee. The sample was selected using purposive sampling, aligning with a quantitative research approach. Data from 27 companies were analyzed using Partial Least Square methods. The findings indicate that profitability does not significantly impact tax avoidance, while leverage exhibits a notable negative relationship with tax avoidance. Furthermore, the study reveals that the audit committee's oversight does not affect the relationship between profitability and tax avoidance. However, when leverage is under the audit committee's control, it substantially reduces instances of tax avoidance. Implications of this study suggest that firms with higher leverage tend to engage in less tax avoidance, likely due to the audit committee's monitoring and oversight role. The audit committee's ability to scrutinize and constrain the use of leverage for tax minimization purposes appears to be an effective deterrent against aggressive tax avoidance practices.

Abstract: Despite the growing scrutiny on environmental, social, and governance (ESG) practices within the global textile sector, existing literature remains fragmented regarding how greenwashing and measurement frictions propagate into capital market information risk, particularly in ASEAN emerging economies. This study addresses this gap and maps the research frontier at the intersection of ESG, greenwashing, and the textile value chain. Using a PRISMA-guided systematic review of Scopus-indexed publications (2000–2025), we conduct bibliometric and content analyses with VOSviewer and Bibliometrix, incorporating robustness tests for threshold and clustering choices. Corresponding to our research objectives, the results indicate: (i) a significant trajectory of interest evidenced by a sharp post-2020 publication surge; (ii) the identification of four thematic clusters: consumer legitimacy and direct/vicarious greenwashing; ESG metrics, governance drivers and assurance; traceability, circularity and digital technologies in multi-tier supply chains; and verification, risk and market consequences; and (iii) critical evidence that rating disagreement and opacity in wet-processing tiers intensify information risk where disclosure and audit capacity are weak. We contribute a replicable knowledge map, an integrative disclosure–assurance framework, and facility-verifiable "say–do" indicators to support research and governance of sustainability-linked investment.

Abstract: Small and medium-sized enterprises (SMEs) are central to Africa's economy but face persistent challenges in volatile, uncertain, complex, and ambiguous (VUCA) environments. This study examines how Artificial Intelligence (AI) can support resource-constrained SMEs in enhancing resilience, efficiency, and competitiveness. Drawing on a systematic literature review of 95 peer-reviewed articles and bibliometric analysis, the paper map's key themes and trends in AI adoption among African SMEs. Findings show that AI applications such as predictive analytics, chatbots, and automation are mainly used to improve efficiency, agility, and decision-making, though adoption is constrained by high costs, limited skills, and weak infrastructure. Guided by the Resource-Based View and Diffusion of Innovations frameworks, the analysis positions AI both as a strategic resource and as a socially embedded innovation. The study contributes by highlighting policy priorities digital infrastructure, regulatory clarity, and incentives and practical strategies for capacity-building and ecosystem partnerships to foster sustainable SME development.

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Abstract: Small and medium-sized enterprises (SMEs) are central to Africa's economy but face persistent challenges in volatile, uncertain, complex, and ambiguous (VUCA) environments. This study examines how Artificial Intelligence (AI) can support resource-constrained SMEs in enhancing resilience, efficiency, and competitiveness. Drawing on a systematic literature review of 95 peer-reviewed articles and bibliometric analysis, the paper map's key themes and trends in AI adoption among African SMEs. Findings show that AI applications such as predictive analytics, chatbots, and automation are mainly used to improve

Abstract: This study explicitly identifies a gap in the literature by focusing on low-HDI provinces in Indonesia a context rarely explored in depth and using 2015–2019 BPS panel data to analyze complex temporal dynamics. The problem statement is the ambiguity regarding how economic growth and poverty simultaneously affect HDI in underdeveloped regions, with the main finding being surprising as it contradicts conventional hypotheses: economic growth does not always have a significant positive impact, while the influence of poverty on HDI is proven to be more nuanced than traditionally assumed. This study investigates the impact of economic growth and poverty on the Human Development Index (HDI) in four provinces classified under the low HDI category in Indonesia. Using data published by the Central Bureau of Statistics from 2015 to 2019, the research explores the dynamic relationship between these variables over time. The analysis employs econometric modeling with e-views as a tool for hypothesis testing, allowing for a strong evaluation of the proposed framework. Contrary to expectations, the findings reveal surprising results, indicating that economic growth and poverty have complex and nuanced influences on HDI that challenge traditional assumptions. The study concludes by offering insights for policymakers to design more effective, targeted strategies that address the unique challenges of provinces with low HDI levels. Recommendations for future research include incorporating additional variables, such as education quality and healthcare access, to provide a more comprehensive understanding of HDI determinants. These findings contribute to the broader discourse on sustainable development and the interconnectedness of economic growth, poverty alleviation, and human well-being.

NOTE FROM THE EDITORS

As an interdisciplinary indexed journal, *The Journal of Global Business and Technology (JGBAT)* serves academicians and practitioners in the fields of global business and technology management and their related areas. JGBAT is also an appropriate outlet for manuscripts designed to be of interest, concern, and applied value to its audience of professionals and scholars. Readers will note that our attempt to bridge the gap between theory and practice has been successful.

We cannot thank our reviewers enough for having been so professional and effective in reiterating to contributors the need to provide managerial applications of their research. As is now obvious, the majority of the articles include a section on managerial implications of research. We wish to reiterate once again our sincere thanks to JGBAT reviewers for having induced contributors to answer the "so what?" question that every *Journal of Global Business and Technology* article is required to address.

Thank you for your interest in the journal and we are looking forward to receiving your submissions. For submissions guidelines and requirements, please refer to the Manuscript Guidelines at the end of this publication.

N. Delener, Ph.D., Editor-in-Chief
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GREEN INNOVATION, SUSTAINABILITY DISCLOSURE, AND FIRM VALUE: EVIDENCE FROM INDONESIA

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ABSTRACT

This research examines whether green innovation affects sustainability disclosure and firm value among firms listed on the Indonesia Stock Exchange. Using 438 firm-year observations (2019-2024) from firms that publish sustainability reports, the analysis employs ordinary least squares regressions to test the hypothesis. Applying the Heckman regression to validate the robustness of our findings, the results show a negative impact of green innovation on firm value and sustainability disclosure. This research presents a novel and multidimensional measure of green innovation by incorporating five key components – green processes, green products, green organizational culture, green supply chains, and green marketing – capturing broader organizational commitment beyond patent counts or R&D expenditures. Drawing on signaling and socio-political perspectives, the findings suggest that innovation-driven sustainability initiatives may generate adverse signals in emerging markets when costs are front-loaded, benefits are delayed, and credibility is uncertain. The findings highlight the importance of strategic alignment between innovation and reporting. Managerially, green innovation programmes should be supported by credible reporting and assurance mechanisms, while policymakers can strengthen disclosure infrastructure and incentives to enhance the credibility and comparability of sustainability information.

Keywords: emerging markets, firm value, green innovation, Indonesia Stock Exchange, sustainability disclosure.

JEL Classifications: G32, M41, O31, Q56

INTRODUCTION

Green innovation has become an increasingly strategic imperative for companies worldwide in addressing environmental degradation and responding to heightened global awareness of sustainable development (Gloria, 2025; Javed et al., 2026). In response to increasing stakeholder pressure and consumer demand for eco-friendly products, companies are adopting green innovations that enhance their environmental performance while simultaneously striving to maintain competitiveness in the market (Khalil & Nimmanunta, 2023; Xiao et al., 2024). Beyond its environmental and social contributions, green innovation also holds significant potential to drive operational efficiency, profitability, and competitive advantage, although these outcomes often depend on the regulatory and market context (Batool et al., 2025; El-Kassar & Singh, 2019; X. Xie et al., 2019). In this context, the international management community should recognize sustainability and corporate social responsibility as crucial contextual factors influencing innovation and entrepreneurial strategy (Mensah, 2019; Mutanho & Shumba, 2024; Vallaster et al., 2019). Early evidence, particularly from emerging markets such as Indonesia, indicates that adopting green innovation and transparent sustainability disclosure helps align corporate strategies with stakeholder expectations, which in turn supports increased firm value.

In Indonesia, the tension between rapid economic expansion and increasing environmental risks has amplified the importance of integrating green innovation into corporate strategies. As an emerging economy with diverse industrial structures and relatively young ESG institutions, Indonesia offers a unique setting to investigate whether green innovation aligns with financial and disclosure performance. For instance, Indonesia's carbon emission levels remain among the highest in Southeast Asia, yet firms face limited enforcement and mixed incentives in pursuing green innovation. Firm value, a critical measure of a company's financial health and investor appeal, is influenced by factors such as profitability, growth potential, and risk profile (Agustia et al., 2019; Ramli et al., 2022). Founder CEOs may shape ESG performance in emerging markets, and that energy-transition pressures influence firms' sustainability-related decisions, which may in turn affect sustainability disclosure (Bilalli et al., 2025; Kim & Kiymaz, 2025). Meanwhile, sustainability disclosure serves as a vital mechanism for communicating a firm's environmental, social, and governance (ESG) initiatives, enabling stakeholders to evaluate its commitment to sustainability and environmental stewardship (Itan et al., 2025; Khan, Singh, et al., 2021; Srouji et al., 2023). The country's ESG reporting landscape is also evolving, with many firms still in the early stages of compliance with sustainability standards, such as those set by the Global Reporting Initiative (GRI) and the OJK's Sustainable Finance Roadmap.

Despite the potential benefits, the adoption of green innovation is not without challenges. High implementation costs, integration issues with existing systems, and delayed financial returns can complicate its impact on firm value and sustainability disclosure. Additionally, firms may engage in selective reporting practices, emphasizing favorable outcomes while neglecting challenges, thereby undermining the credibility of their sustainability disclosures (Qian & Schaltegger, 2017; Sun et al., 2021). These complexities are particularly pronounced in developing economies like Indonesia, where regulatory frameworks and institutional support for sustainability initiatives are still maturing (Dai & Xue, 2022; Hapsoro & Fadhilla, 2017).

While existing research highlights the mixed effects of green innovation on firm value and sustainability reporting, significant gaps remain. For instance, Agustia et al. (2019), Yao et al. (2019), Hidayat et al. (2024), and L. Liu (2023) found that environmentally friendly innovations enhance firm value, especially when aligned with robust regulatory frameworks. Conversely, other studies, such as those by Z. Xie et al. (2022) and Yao et al. (2019), suggest that eco-process and eco-product innovations negatively impact firm value. Research on the influence of green innovation on sustainability reporting also presents varying conclusions. Orazalin and Mahmood (2018) highlight that firms implementing green

innovation disclose more transparent environmental performance information, thereby enhancing overall sustainability disclosure.

This research aims to examine the impact of green innovation on sustainability disclosure and firm value in Indonesia. Distinguishing itself from prior research, it adopts a comprehensive measurement framework for green innovation, encompassing five dimensions: green process innovation, green product innovation, green organizational culture innovation, green supply chain management, and green marketing (Rachmawati, 2023). This multidimensional framework captures not only technical innovation but also cultural and strategic shifts within organizations. This research is important given the inadequate measurement of green innovation in previous research.

The remainder of the paper is structured as follows: The next section reviews relevant literature and develops hypotheses. We then describe research design, report the main findings and robustness analyses, conclude with implications and recommend for future research.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Grand theory

Several theories have emerged to forecast how companies will disclose ESG issues depending on their organizational characteristics. The theoretical foundations of sustainability disclosure can also be traced to environmental disclosure theories, which are categorized into socio-political (Gray et al., 1995) and signaling (Spence, 1973) theories. Socio-political theory is based on two main principles: legitimacy theory and stakeholder theory. Legitimacy theory suggests that a company's survival hinges on societal approval, driving it to disclose non-financial information, such as carbon emissions, to align with societal values. In contrast, stakeholder theory asserts that companies disclose information to meet expectations and use environmental reports to build support and ensure sustainability (Awa et al., 2024; Nasih et al., 2019). Both legitimacy and stakeholder theories argue that firms engage in voluntary carbon disclosure to legitimize their actions and balance the expectations of diverse stakeholders. Signaling theory posits that green innovation signals reliability and commitment to sustainability, reducing information asymmetry between management and investors (Connelly et al., 2011). These theories help explain the link between green innovation, sustainability disclosure, and firm value. However, if the outcomes of green innovation are unclear or the costs outweigh the benefits, the signal can become negative and negatively affect perceived firm value.

Green innovation

Green innovation, defined as innovation that is novel, valuable, resource-efficient, and environmentally beneficial, is often not clearly distinguished from ecological and sustainable innovation in the field of science and technology management (Mahsina & Agustia, 2023; Shpak et al., 2021; Us et al., 2022). However, the uncertain effectiveness of green innovation, a significant topic of academic inquiry, is influenced by external factors such as stakeholders, government policies, and societal expectations, as emphasized by Hojnik and Ruzzier (2016) regarding the roles of government, shareholders, and consumers in driving enterprise green innovation. In Indonesia, green innovation involves the development and application of environmentally friendly technologies and practices to reduce environmental impact (Dharmayanti et al., 2023; Nuryanto et al., 2024; Yang & Iskandar, 2021).

Sustainability disclosure

Sustainability encompasses environmental issues and business practices aimed at meeting current needs while conserving resources for future generations, with many companies globally adopting it as a mainstream approach (Amacha & Dastane, 2017). These companies pursue eco-efficiency and social equity through responsible resource management and align their strategies with sustainability principles, often requiring organizational adaptation and change (Martins et al., 2019). Sustainable corporate value requires more than financial strength, as integrating sustainability creates competitive advantage and long-term success, enhancing managerial competence and operational efficiency. This has led many multinational corporations to prioritize innovation aligned with sustainability principles and the emergence of sustainability reporting guided by GRI standards to meet stakeholder needs (Hapsoro & Fadhilla, 2017; Harymawan et al., 2020; Hussain et al., 2018).

Firm value

A higher firm value enhances investor confidence in both current performance and future potential, reflecting public trust and corporate worth. It serves as a key measure of overall success, linked to factors like share price (Dai & Xue, 2022; Ramli et al., 2022). To enhance shareholder welfare, firms optimize value using financial metrics like revenue growth and earnings per share, along with non-financial indicators like brand recognition. In Indonesia, firm value is often assessed through share price, EPS, and P/E ratios (Amacha & Dastane, 2017; Husnaini & Tjahjadi, 2021). Additionally, the economic environment in Indonesia, characterized by regulatory changes and market volatility, also affects firms' value, making it crucial for companies to adapt strategically in order to maintain and increase their value in the eyes of investors and the market (Z. Xie et al., 2022; Yao et al., 2019).

Hypotheses development

Green innovation and firm value

Firm value reflects investors' valuation of a firm's expected future cash flows and growth prospects and is commonly proxied by Tobin's Q in empirical studies (M & Sasidharan, 2020; Salihi et al., 2024). Although green innovation can create long-run benefits, it often requires substantial up-front investment and organizational change, while financial gains may be delayed or uncertain – conditions that can depress short-run profitability and market valuation (Hermundsdottir & Aspelund, 2021). Recent evidence indicates that the valuation effect of green innovation is heterogenous: pollution-prevention innovation is more likely to translate into future financial benefits, whereas pollution-control innovation may improve environmental performance without clear financial payoffs (Cheng et al., 2025). Moreover, the relationship between green innovation and market-based performance can be non-linear, implying that beyond certain intensity levels, marginal innovation investment may be discounted by the market due to escalating costs and execution risk (Leyva-de la Hiz & Bolívar-Ramos, 2022; Dai & Xue, 2022). In emerging markets where disclosure quality and enforcement are still evolving, investors may further discount green innovation if they suspect symbolic adoption or fear reputational and regulatory backlash linked to perceived greenwashing (Xu et al., 2025). Consistent with this cost-and-risk logic, studies in environmentally intensive contexts document short-run valuation discounts and lower Tobin's Q associated with green innovation when implementation risk and front-loaded investment dominate (Z. Xie et al., 2022; Xiao et al., 2024; Batool et al., 2025).

H_1: There is a significant negative impact between green innovation and firm value, such that higher green innovation is associated with lower levels of firm value.

Green innovation and sustainability disclosure

Sustainability disclosure involves the public reporting of a company's ESG performance and impacts (Harymawan et al., 2021; Kashi et al., 2024). While broader disclosure can reduce information asymmetry, firms may rationally limit disclosure when reporting creates proprietary, regulatory, or litigation costs—especially under stronger regulatory scrutiny and enforcement risk (Zakota, 2025). Moreover, the capital-market benefits of ESG disclosure are not uniform for resource-constrained firms; for SMEs, environmental/ESG disclosure can be associated with a higher cost of capital in some settings, implying that the net benefit of disclosure is context-dependent (Gjergji et al., 2021). In this setting, firms that invest aggressively in green innovation may prioritise operational implementation over extensive reporting, and they may avoid detailed sustainability narratives to reduce exposure to accusations of selective disclosure or greenwashing—concerns that can trigger adverse market reactions (Xu et al., 2025). Although high-quality climate-risk disclosure can help mitigate greenwashing incentives (Battisti et al., 2025), producing credible and verifiable disclosure typically requires data systems and assurance that remain costly and still developing in many emerging economies. Accordingly, given that our measure captures the breadth of GRI-based disclosure items, resource diversion and proprietary-cost concerns imply that firms undertaking more intensive green innovation disclose fewer sustainability items; hence, we expect a negative association between green innovation and sustainability disclosure in Indonesia.

H_2: There is a significant negative impact between green innovation and sustainability disclosure, such that higher green innovation is associated with lower levels of sustainability disclosure.

RESEARCH METHODOLOGY

Sample and data

The author analyzes sustainability reports from 438 firm-year observations in Indonesia, covering the years 2019 to 2024. The sample consists of Indonesian companies that consistently publish complete sustainability reports each period in accordance with GRI standards. Regulatory obligations for financial institutions and publicly traded corporations, which began in 2019, as well as listed companies adopting these obligations in 2020 (though implementation was postponed until 2021 due to the COVID-19 pandemic), drove the growth in sustainability reporting during this era. According to PwC Indonesia's Asia Pacific Sustainability Counts II Report, there was a notable increase in climate-related risk and opportunity disclosures within sustainability reports, from 77% in 2021 to 88% in 2022 (PwC, 2023), marking this period as a pivotal era for sustainability reporting in Indonesia. By focusing on 2019-2024, research can analyze the early stages of this development and track how companies adapt and implement sustainability reporting in response to new regulatory pressures. This research uses winsorizing to limit extreme values by capping data at specific percentiles, reducing the impact of outliers on the analysis. It also incorporates leverage, growth, firm size, profitability, firm age, and liquidity as control variables, consistent with prior research that has employed these controls (Husnaini & Tjahjadi, 2021; Z. Xie et al., 2022; Yao et al., 2019). This research employs OLS regression to test our hypotheses and adds Heckman Two-Stage Regression analysis, along with several additional analyses, to ensure that our results are robust.

Operational variable measurement

This research involves nine variables, consisting of two dependent variables, one independent variable, and six control variables. Our dependent variables are firm value and sustainability disclosure. Tobin's Q ratio was utilized to calculate a firm's value. Tobin's Q is calculated by dividing the sum of the market value of a company's equity and its total debt by the company's total assets (Salihi et al., 2024). Sustainability disclosure is assessed according to the Global Reporting Initiative (GRI) guidelines. The GRI framework is commonly used in research on ESG, sustainability, or CSR reporting (Kashi et al., 2024; Yopie & Robin, 2023). This is because the framework is constantly being updated to reflect the latest developments in sustainability reporting. The independent variable is green innovation. This research measures it using the formula proposed by Rachmawati (2023), which calculates the percentage of the total

number of disclosed items in each element out of the total number of items in each element. The element consists of five dimensions: green process innovation, green product innovation, green organizational culture, green supply chain management, and green marketing, which are further broken down into 19 indicators, as detailed in Table 1. These measures were selected because prior research by Dai and Xue (2022) and M. Liu et al. (2024) on green innovation typically includes only two dimensions: green process innovation and green product innovation, or they are measured by patents. These two dimensions are challenging to address in the context of 4.0-era competition and global environmental issues. In the competitive 4.0 era, where innovation is required not only in products and processes but also in resource management, marketing, and organizational culture, this approach is applicable. By incorporating these five factors, companies can better respond to global issues and changing customer attitudes toward sustainability.

Table 1. Indicators within each dimension for measuring green innovation

Measurement of green innovation	
Dimensions	**Indicators**
Green process innovation (G1)	• Reducing consumption of water, electricity, coal, and oil • Lowering emissions of hazardous substances or waste • Minimizing the use of raw materials in production processes
Green product innovation (G2)	• Selection of product materials that produce the least pollution • Utilizing materials effectively during product development • Employing materials that are easily recyclable or biodegradable
Green organizational culture (G3)	• The company promotes employee awareness of environmental conservation • The company has a clear policy supporting environmental awareness • Environmental conservation is a top priority for the company • Environmental sustainability is a core value of our company • Environmental goals are aligned with corporate objectives • The company creates products and processes designed to minimize environmental impact
Green supply chain management (G4)	• Holds ISO 9000/14000 certification • Engages in green distribution and marketing practices • Implements reverse logistics and uses recyclable packaging • Establishes close supplier relationships by setting criteria for purchasing and evaluating material quality • Ensure product quality meets customer needs
Green marketing (G5)	• The company maintains a positive environmental brand image • The company uses digital marketing strategies in place of less recyclable billboards or banners

Table 2. Measurement of research variables

Variable	Label	Measurement	Sources
Dependent variables			
Firm value	FV	(Market value of equity + debt) to total asset	(Salihi et al., 2024)
Sustainability disclosure	SD	Sum of sustainability item codes across all sustainability components divided by total potential disclosure score for sustainability dimensions.	(Kashi et al., 2024)

Independent variables			
Green innovation	GI	Percentage of total item disclosed each element to total number of items in each element	(Rachmawati, 2023)
Control variables			
Leverage	LEV	Total debt to total assets ratio	(Samy El-Deeb et al., 2023)
Firm growth	Growth	Percentage of the annual growth in net sales or revenues	(Kim & Kiymaz, 2025)
Firm size	FSIZ	Logarithm of firm's total assets	(Husnaini & Tjahjadi, 2021)
Profitability	PROFT	Operating profit to total assets	(Helfaya et al., 2023)
Liquidity	Cash	Current assets to current liabilities ratio	(Boshnak, 2023)
Firm age	FirmAge	Number of years since incorporation	(Edi & Wati, 2022)

Empirical model

This research estimates the OLS regressions with year and industry fixed effects to test the hypotheses. Following prior empirical work, all continuous variables are winsorised at the 1st and 99th percentiles to reduce the influence of outliers, and heteroskedasticity-robust standard errors are applied. The baseline models are specified as follows:

Model 1:

$$FV_{i,t} = \alpha_1 + \beta_1 GI_{i,t} + \beta_2 LEV_{i,t} + \beta_3 Growth_{i,t} + \beta_4 FSIZ_{i,t} + \beta_5 PROFT_{i,t} + \beta_6 Cash_{i,t} + \beta_7 FirmAge_{i,t} + Industry_{i,t} + Year_{i,t} + \varepsilon \quad (1)$$

Model 2:

$$SD_{i,t} = \alpha_2 + \beta_8 GI_{i,t} + \beta_9 LEV_{i,t} + \beta_{10} Growth_{i,t} + \beta_{11} FSIZ_{i,t} + \beta_{12} PROFT_{i,t} + \beta_{13} Cash_{i,t} + \beta_{14} FirmAge_{i,t} + Industry_{i,t} + Year_{i,t} + \varepsilon \quad (2)$$

RESEARCH RESULTS AND DISCUSSION

Pearson correlation test

Table 3 elucidates the Pearson correlation of each variable, indicating that GI, FSIZ, Cash, and FirmAge show no correlation with SD. Conversely, LEV, Growth, and profitability exhibit a significant positive correlation with firm value at the 1% level. The table also reveals that green innovation, leverage, growth, liquidity, and firm age are unrelated to firm value, while firm size and PROFT demonstrate a significant positive correlation with FV at the 1% level. Pearson correlation is also utilized to detect multicollinearity among independent variables. A Pearson correlation greater than 0.80 suggests a high correlation, indicative of multicollinearity (Saunders et al., 2019). However, Table 3 shows that each independent variable has a correlation below 0.80, indicating the absence of multicollinearity among them.

Table 3. Pearson Correlation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SD (1)	1.000								
FV (2)	0.032	1.000							

	(0.498)								
GI (3)	-0.128***	-0.197***	1.000						
	(0.007)	(0.000)							
LEV (4)	-0.130***	0.031	0.043	1.000					
	(0.007)	(0.523)	(0.368)						
Growth (5)	0.081*	0.011	-0.069	-0.041	1.000				
	(0.089)	(0.821)	(0.149)	(0.398)					
FSIZ (6)	0.043	-0.173***	0.044	0.304***	-0.003	1.000			
	(0.374)	(0.000)	(0.361)	(0.000)	(0.951)				
PROFT (7)	0.201***	0.175***	-0.152***	-0.511***	0.127***	-0.089*	1.000		
	(0.000)	(0.000)	(0.001)	(0.000)	(0.008)	(0.062)			
Cash (8)	0.010	0.049	-0.009	-0.059	0.005	0.026	0.019	1.000	
	(0.832)	(0.304)	(0.851)	(0.219)	(0.916)	(0.582)	(0.694)		
FirmAge (9)	0.014	-0.010	-0.072	0.228***	-0.058	0.436***	0.075	0.014	1.000
	(0.768)	(0.839)	(0.133)	(0.000)	(0.225)	(0.000)	(0.115)	(0.774)	

This table presents the findings of Pearson Correlation analysis conducted on 438 observations of firm-years utilized in this research. The analysis utilized winsorized data at both the 1st and 99th percentiles. p-values in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Regression results

Based on the findings presented in Table 4, the coefficient for GI demonstrates a statistically significant negative impact of -2.193 at the 1% significance level, indicating that higher levels of green innovation in the firm are associated with a decrease in firm value. Therefore, Hypothesis 1 is supported by these results. Furthermore, this research also identifies a statistically significant negative coefficient of -0.102 for GI at the 5% significance level, suggesting that an increase in green innovation correlates with reduced sustainability disclosure. Thus, Hypothesis 2 is confirmed based on these findings.

Table 4. GI to FV and SD

Variables	FV	SD
GI	-2.193***	-0.102**
	(-3.30)	(-2.55)
LEV	1.559**	-0.024
	(2.17)	(-0.75)
Growth	-0.000	0.000***
	(-1.40)	(3.13)
FSIZ	-0.175**	0.021***
	(-2.11)	(3.26)
PROFT	6.368**	0.110
	(2.55)	(1.41)
Cash	0.198	-0.008**
	(0.95)	(-2.18)

FirmAge	-0.006	-0.000
	(-0.96)	(-0.62)
_cons	6.381**	-0.235
	(2.43)	(-1.20)
Industry FE	Yes	Yes
Year FE	Yes	Yes
r2	0.241	0.411
r2_a	0.203	0.381
N	438	438

t statistics in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Green innovation initially impacts a firm's value negatively, reflected in Tobin's Q, due to substantial upfront investments in sustainable technologies and practices that may not immediately enhance profitability or market share. Socio-political theory suggests that green innovation is driven more by regulatory pressures or social expectations than by genuine strategic benefits (Hermundsdottir & Aspelund, 2021; Yao et al., 2019). Signaling theory posits that green innovations serve as signals of a firm's commitment to sustainability. However, if these innovations don't produce expected results or are perceived as mere greenwashing, they can lead to skepticism and reduced investor confidence, negatively affecting firm value (Cumming et al., 2023; Leyva-de la Hiz & Bolívar-Ramos, 2022). This situation can lead investors to perceive lower short-term financial returns and heightened financial risk. Consequently, these financial challenges temporarily decrease market value, highlighting investor concerns about the profitability and competitiveness of green initiatives in the short run (Z. Xie et al., 2022; Yao et al., 2019). The research uncovers a negative impact between green innovation and sustainability disclosure. Socio-political theory proposes that organizations, facing external pressures, prioritize green innovation over comprehensive sustainability reporting due to increased scrutiny and regulatory obligations, potentially undermining transparency (Sundarasen et al., 2024). Conversely, signaling theory suggests that organizations may rely on visible green initiatives as proof of commitment, which reduces the need for detailed disclosure and calls for policies that incentivize innovation and transparency in sustainable practices (Rehman et al., 2021; Wang et al., 2022). The negative impact of green innovation on sustainability disclosure refers to a scenario where a company's increased efforts to develop environmentally friendly technologies and practices often result in a reduced level of transparency and detail in its sustainability disclosures (Khan, Johl, et al., 2021). When companies focus heavily on green innovation, they may shift their resources and focus away from producing thorough sustainability reports (Hermundsdottir & Aspelund, 2021; Khan et al., 2021).

Robustness tests

Since endogeneity is a major issue in this research, the research conducted a Heckman Two-Stage Regression analysis to address this problem. The findings presented in Table 5 indicate that the results are qualitatively consistent with the main findings. The estimated coefficient for GI on FV is -2.421, with statistical significance at the 1% level (t = -3.675). Meanwhile, the estimated coefficient for GI on SD is -0.114, with statistical significance at the 1% level (t = -2.812). The findings from this two-step Heckman model indicate that there is selection bias present in the analyzed sample. In the initial phase, the GI variable shows a significant negative correlation with the selection choice, whereas MEAN_GI exhibits a significant positive association. The adjustment for selection bias through the Mills ratio is likewise important. In the second phase, the findings indicate that GI has a negative correlation with the dependent variable (FV), although the impact is less pronounced than in the first phase. The Mills ratio shows no significance in the second stage, suggesting that the selection bias has been effectively addressed. In general, this Heckman

model demonstrates that once selection bias is addressed, the analysis of the relationship between the independent and dependent variables can be conducted more accurately.

Table 5. Heckman Two Stage Regression

Variables	First Stage	Second Stage	
	d_GI	FV	SD
GI		-2.421***	-0.114***
		(-3.675)	(-2.812)
MEAN_GI	6.423***		
	(3.928)		
MILLS		-1.103	-0.060
		(-1.389)	(-1.522)
_cons	-5.282***	8.988**	-0.093
	(-2.619)	(2.422)	(-0.434)
Controls	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
r2_p	0.137	0.245	0.414
F		6.488	45.881
N	438	438	438

Additional tests

To strengthen our analysis and contribution, this research also conducted an additional analysis of the five dimensions of green innovation measurement. Table 6 presents the analysis results by detailing the five dimensions of green innovation measurement. For FV, display the significant effect variants, such as 10%, 5%, and 1%, for G1, G2, G3, G4, and G5. At the 1% significance level, G1 has the most negative impact, followed by G4, which is significant at the 5% level. Although they are only significant at the 10% level, G2, G3, and G5 likewise have detrimental impacts. According to these data, the main factors influencing this reduction are G1 and G4, and a greater adoption of such green practices tends to lower firm value. Even while these characteristics of green innovation may eventually have positive consequences, external factors including limited market adoption, higher upfront costs, and unique industry obstacles may limit their short-term impact on company value. This underscores the necessity for a nuanced comprehension of the time-related dynamics between green innovation efforts and company value, particularly in developing markets such as Indonesia.

Regarding SD, G1 and G3 do not significantly impact sustainability disclosure, suggesting that these initiatives may not yet be fully integrated into the company's sustainability reporting. G2 shows a significant negative effect in one model at the 1% significance level (coefficient = -2.680), indicating that while green products are crucial, their development might pose challenges that hinder overall sustainability disclosure. This negative effect implies that creating green products could be intricate and resource-demanding, possibly redirecting focus our resources from broader sustainability reporting initiatives. Similarly, G4 and G5 negatively influences SD in one model at the 5% significance level (coefficient = -2.171 and -2.405), suggesting that green supply chain management and marketing efforts might face challenges in effectively contributing to sustainability disclosures. Although promoting green products is crucial for a company's image, such initiatives are not viewed as adequate or clear in bolstering the larger sustainability story. It also indicates challenges in coordinating marketing efforts with quantifiable sustainability results. In summary, the results suggest that while green innovations are essential, their

current implementation may present challenges that negatively impact both firm value and sustainability disclosure in certain contexts.

Table 6. Measuring 5 dimensions of GI to FV

Variables	**FV**				
G1	-1.221***				
	(-3.721)				
G2		-0.569*			
		(-1.677)			
G3			-0.929*		
			(-1.906)		
G4				-1.196**	
				(-2.579)	
G5					-0.692*
					(-1.708)
_cons	5.815**	5.209*	5.263**	5.587**	5.195*
	(2.123)	(1.938)	(2.051)	(2.147)	(1.902)
Controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
r2	0.239	0.228	0.230	0.235	0.230
r2_a	0.201	0.189	0.191	0.196	0.191
N	438	438	438	438	438

Table 7. Measuring 5 dimensions of GI to SD

Variables	**SD**				
G1	0.009				
	(0.367)				
G2		-0.064***			
		(-2.680)			
G3			-0.041		
			(-1.315)		
G4				-0.059**	
				(-2.171)	
G5					-0.061**
					(-2.405)
_cons	-0.447**	-0.490**	-0.452**	-0.443**	-0.452**
	(-2.013)	(-2.255)	(-2.020)	(-1.997)	(-2.051)
Controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
r2	0.513	0.521	0.513	0.516	0.520
r2_a	0.481	0.490	0.481	0.485	0.489
N	438	438	438	438	438

CONCLUSION

This research examines the impact of green innovation on sustainability disclosure and firm value using 438 firm-year observations of Indonesian listed firms (2019-2024) that publish sustainability reports. The results indicate that green innovation is negatively associated with Tobin's Q and with the breadth of GRI-based disclosure items, and these findings remain robust after addressing potential selection bias using a Heckman two-stage model.

The findings extend the green innovation literature by showing that market and disclosure responses to green initiatives can be negative in the short run when innovations are costly, benefits are delayed, and the credibility of sustainability signals is uncertain. Integrating socio-political and signaling perspectives, we argue that investors may discount green innovation in emerging markets when they suspect symbolic adoption or fear regulatory and reputational backlash, while firms may limit disclosure breadth due to resource diversion and proprietary-cost considerations.

Managerially, firms should sequence green innovation investments with investments in measurement, data systems, and internal controls so that sustainability claims can be supported by verifiable evidence; where feasible, external assurance can further enhance credibility and reduce greenwashing concerns. From a policy perspective, regulators (e.g., OJK/IDX) can strengthen the comparability and reliability of sustainability reporting by providing clearer disclosure templates aligned with GRI, promoting assurance standards, and offering targeted incentives for substantive (pollution-prevention) innovation rather than symbolic initiatives. These actions can improve the informational value of sustainability disclosure and help align green innovation with long-term value creation.

This research has several limitations. First, the inconsistent publication of financial and sustainability reports by IDX-listed companies has reduced the sample size. Second, focusing only on IDX-listed companies and publicly available data limits the analysis of advanced control mechanisms. Further research with a larger sample is needed to improve generalizability. Third, environmental challenges vary across developing countries, so the findings may not be universally applicable. Fourth, green innovation alone may not adequately assess firm value in Indonesia; factors such as energy efficiency, carbon emissions, and government policies are also important. Finally, future research should collect primary data through surveys or interviews, include a wider range of independent variables, and extend the research period.

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ENHANCING PLATFORM CREDIBILITY IN THAI E-COMMERCE: RECALIBRATING INFLATED STAR RATINGS VIA SENTIMENT ANALYSIS

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ABSTRACT

This study addresses the erosion of platform credibility in international e-commerce caused by the misalignment between numerical star ratings and actual textual sentiment. While star ratings are a dominant mechanism guiding purchasing decisions in rapidly expanding markets like Southeast Asia, they are frequently inflated due to platform-induced biases and region-specific cultural factors, such as the politeness norms and indirect communication strategies prevalent in Thai culture. To overcome this structural limitation, this research aims to empirically quantify this discrepancy and introduce a transparent, sentiment-informed metric—the "Heart Score"—to recalibrate ratings. A rule-based sentiment analysis framework specifically adapted for Thai-language reviews was applied to a dataset of 14,877 women's clothing entries from Lazada. By leveraging expert-validated lexicons and linguistic rules for negation and amplification, store-level sentiment ratios were extracted and transformed into recalibrated scores via a normalized linear function with penalty adjustments. Findings confirm substantial sentiment misalignment: although the analyzed stores clustered narrowly with star ratings between 4.92 and 5.00, the recalibrated Heart Scores spanned a significantly wider, more meaningful range of 3.81 to 4.71. The most notable gap of 1.11 points exposed hidden dissatisfaction masked by near-perfect ratings. The proposed framework offers strong managerial insights for platform governance by enhancing review credibility, enabling more accurate product benchmarking, and providing a scalable, interpretable model for restoring trust in low-resource language environments.

Keywords: Platform Credibility, Sentiment Analysis, Star Rating Recalibration, Thai E-Commerce, Rule-Based Model

INTRODUCTION

The digital transformation of retail has profoundly reshaped consumer behavior worldwide, with Southeast Asia emerging as one of the fastest-growing e-commerce markets. Online platforms such as Lazada, Shopee, and Tokopedia have experienced rapid adoption, driven by their convenience, expansive product offerings, and competitive pricing strategies. According to the Statista Research Department

(2024), the Southeast Asian e-commerce market reached a valuation of $159 billion in 2024 and is projected to surpass $370 billion by 2030. This growth signals a major shift in purchasing behavior from traditional brick-and-mortar retail to digital marketplaces. In Thailand, this e-commerce boom has been particularly pronounced, largely fueled by the widespread adoption of mobile shopping. A report by TMO Group (2024) noted that Thailand had the highest e-commerce penetration rate in Southeast Asia—nearly 67%—with over 70% of transactions occurring via mobile platforms. This illustrates a significant transition toward digital-first consumption habits in everyday life. Furthermore, the COVID-19 pandemic accelerated this shift, leading to a 45.05% increase in online retail spending between 2020 and 2021.

As these platforms mature, the mechanisms governing trust and reputation have become critical to their continued success. Wahab et al. (2023) highlight that while digital platforms provide the essential infrastructure for online entrepreneurship, their long-term viability depends heavily on the integration of customer knowledge and robust trust mechanisms. Within this ecosystem, fashion—especially women's clothing—has emerged as one of the most active and high-volume categories. Lazada, a leading player in the regional online marketplace, has capitalized on this momentum by offering interactive features such as customer reviews and star ratings. These user-generated signals enable direct engagement between buyers and sellers, shaping purchasing decisions and influencing product visibility. However, the credibility of numerical star ratings as reliable indicators of consumer satisfaction remains in question—particularly in cultural contexts like Thailand, where indirect communication norms and politeness strategies may obscure actual sentiment.

Given these challenges, this study seeks to address the persistent gap between inflated numeric star ratings and the actual sentiment conveyed in Thai-language product reviews on the Lazada platform. While prior research has identified the limitations of numerical ratings and explored various sentiment analysis techniques, there remains a need for interpretable, language-sensitive models that can recalibrate user ratings to reflect true consumer sentiment—particularly in culturally nuanced, low-resource environments. To this end, the present study sets out with three primary objectives: (1) to empirically assess the extent of discrepancy between user-assigned star ratings and sentiment polarity in review texts; (2) to develop and implement a transparent, rule-based sentiment analysis model tailored specifically to Thai-language consumer reviews; and (3) to propose a recalibrated, sentiment-informed rating metric—termed the "Heart Score"—that offers a more accurate and interpretable reflection of customer sentiment than traditional star ratings.

LITERATURE REVIEW

To understand the erosion of platform credibility in Thai e-commerce, it is necessary to move beyond a descriptive overview of sentiment analysis and critically examine the structural and cultural mechanisms that render traditional star ratings inadequate. The literature can be synthesized into four critical streams: the reliability crisis of numerical ratings, the limitations of conventional sentiment models, the role of cultural politeness, and the specific sociolinguistic gaps in Thai research.

The Reliability Crisis of Star Ratings

While user-generated reviews and star ratings have become essential tools for guiding consumer decisions, their reliability is increasingly compromised by systemic inflation. Numerical star ratings are particularly appealing for their simplicity, offering a quick visual summary of product quality. However, critical studies (Mudambi & Schuff, 2012; Hutto & Gilbert, 2014) have highlighted inherent limitations of this format, notably that numeric scores often fail to capture the nuanced sentiment conveyed in accompanying review texts. Factors contributing to this misalignment include platform-induced user bias

and cultural tendencies to avoid explicit criticism. Early research by Hu, Pavlou, and Zhang (2009) identified a pervasive "J-shaped" distribution in online reviews, where ratings are heavily skewed toward the extreme positive (5 stars), rendering the mean rating a biased estimator of product quality.

Recent research by Nguyen et al. (2023) further emphasizes that customer feedback and star ratings are decisive factors directly affecting product sales on e-commerce platforms. Their findings suggest that when these signals are inaccurate or inflated, they not only mislead consumers but also disrupt the feedback loop necessary for sellers to improve service quality. Fazzolari et al. (2017) and Zhang and Liu (2022) argue that this "positivity bias" creates a credibility crisis for platforms, as the inflated ratings lose their discriminatory power for benchmarking seller performance.

The Limitations of Conventional Sentiment Models

To address platform credibility, sentiment analysis has emerged as a key technique for extracting subjective information (Liu, 2012). However, traditional approaches face significant limitations when applied to the nuances of Thai e-commerce. Lexicon-based methods (Taboada et al., 2011) are favored for transparency but often struggle with contextual nuances like sarcasm or idiomatic expressions. Conversely, machine learning approaches—including Naïve Bayes, SVM, and deep learning models like LSTM and BERT (Zhang, Wang, & Liu, 2018)—offer higher predictive power but often function as opaque "black boxes." Ribeiro, Singh, and Guestrin (2018) critique this lack of interpretability, advocating for transparent models that support accountability in consumer-facing systems. For platform governance, an opaque score is insufficient; stakeholders require an auditable metric that explicitly links score deductions to textual evidence.

Cultural Politeness and Indirect Communication

The disconnect between rating and sentiment is exacerbated by cultural factors, yet standard sentiment analysis models—trained largely on Western datasets—often overlook this dimension. Politeness Theory (Brown & Levinson, 1987) posits that individuals in collectivist cultures (such as Thailand) prioritize "face-saving" and social harmony, often leading to indirect communication strategies. In the context of online reviews, this manifests as a reluctance to assign low numerical scores (which openly damage a seller's "face") while reserving honest, constructive criticism for the text, often softened by polite particles. Scollon and Scollon (2001) describe this as "hierarchical politeness," where negative feedback is encoded subtly. Current sentiment models that fail to account for these cultural amplification and negation rules will inevitably misinterpret the true voice of the Thai consumer. Therefore, a theoretical gap exists for a model that specifically quantifies this "polite inflation."

Gaps in Thai-Specific Sentiment Research

In the context of Thai-language sentiment analysis, unique challenges such as the absence of explicit word boundaries and informal phrasing complicate model development. While recent studies have made technical strides, they often lack a critical focus on the misalignment problem in e-commerce. For instance, Netisopakul and Saewong (2022) focused on stock news, and Thuayhanruksa and Thiengburanathum (2025) benchmarked LLMs like WangChanBERTa on financial headlines. Similarly, Bunyatisai et al. (2025) and Thong-iad and Netisopakul (2020) improved classification accuracy using hybrid models and emoji signals. However, these studies primarily aim to improve polarity detection accuracy rather than addressing the sociolinguistic phenomenon of "polite inflation" where high ratings mask critical text. There is a marked scarcity of research that operationalizes these linguistic insights into

a recalibrated scoring metric that can restore trust in digital marketplaces. This study bridges that gap by integrating Thai linguistic rules into a transparent scoring framework.

RESEARCH HYPOTHESES

Drawing from the critical literature review, this study posits that the observed high ratings in Thai e-commerce are an artifact of cultural and structural biases rather than a true reflection of consumer satisfaction. Grounded in Expectation-Confirmation Theory (ECT) and Politeness Theory, we formulate the following hypotheses to guide the deductive analysis:

- Hypothesis 1 (The Inflation Hypothesis): Numerical star ratings in Thai e-commerce markets exhibit a statistically significant "ceiling effect," characterized by low variance and a skew toward the maximum value, thereby failing to capture the heterogeneity of consumer experiences.
- Hypothesis 2 (The Politeness-Mismatch Hypothesis): There is a significant divergence between user-assigned star ratings and the actual sentiment polarity extracted from review texts. Specifically, textual sentiment will reveal a wider distribution of satisfaction (including "hidden" dissatisfaction) that is masked by the inflated star ratings.
- Hypothesis 3 (The Recalibration Hypothesis): A linguistically adjusted "Heart Score," which penalizes ratings based on negative textual sentiment and cultural nuance, will provide significantly higher discriminatory power in benchmarking vendor performance than traditional star ratings.

METHODOLOGY

This section outlines the methodological framework used to examine sentiment–rating misalignment in Thai-language consumer reviews. The approach integrates systematic data collection, linguistically informed preprocessing, domain-specific lexicon construction, and a transparent rule-based scoring algorithm designed to generate recalibrated *heart scores*. The framework emphasizes interpretability, reproducibility, and suitability for low-resource language environments.

DATA COLLECTION

Review data were obtained through Lazada's publicly accessible API in February 2024 following a targeted sampling strategy designed to ensure linguistic consistency and managerial relevance. To minimize semantic drift and enable cross-vendor benchmarking, the study focused exclusively on women's clothing, a category known for high review volume and sentiment-rich commentary. Ten stores were selected based on product variety and review density, with each store required to have at least one product containing ≥100 Thai-language reviews—a threshold supported by variance testing and prior studies on review analytics.

The initial dataset exceeded 20,000 entries and underwent a multi-stage cleaning protocol:

Deduplication of repeated reviews posted across multiple items
Removal of null or malformed entries
Automated language filtering using langdetect to retain only high-confidence Thai text
Time-window filtering to ensure recency and comparability

Following cleaning, 14,877 high-quality reviews remained. Each review consisted of a product ID, store ID, timestamp, the full review text, and a user-assigned star rating (1–5). This structured dataset supported both text mining and sentiment-based recalibration.

DATA PREPROCESSING

Preprocessing Thai-language text is inherently complex due to the absence of word boundaries, extensive use of colloquial expressions, and the high informality typical of user-generated content. To address these challenges, the study employed a comprehensive pipeline consistent with best practices in Thai NLP (Khamphakdee & Seresangtakul, 2021):

- Tokenization using the newmm engine in PyThaiNLP, which offers high segmentation accuracy for contemporary Thai text (Phatthiyaphaibun et al., 2023).
- Normalization of elongated or stylized expressions (e.g., "มากกกกกก" → "มาก") to reduce lexical sparsity and improve lexicon matching.
- Stopword removal using a combined general-purpose and domain-specific stopword list to isolate sentiment-bearing units.
- Noise filtering, including removal of emojis, symbols, numerals, and excessive punctuation. Although emojis can convey sentiment, their variability and inconsistent usage in Thai reviews justified their exclusion for methodological uniformity.
- Lowercasing and whitespace pruning for textual consistency.
- Final language verification to exclude mixed-language reviews that could compromise scoring accuracy.

This pipeline ensured that sentiment extraction was linguistically grounded and consistent across stores.

SENTIMENT LEXICON CONSTRUCTION

Two domain-specific lexicons—one positive and one negative—were developed as the foundation for the rule-based sentiment scoring mechanism. Construction followed a multi-step process combining corpus-driven extraction, expert validation, and existing Thai sentiment resources (Masdisornchote, 2015; PyThaiNLP corpora; NECTEC Lexitron).

- The positive lexicon includes terms expressing approval or satisfaction (e.g., "สวย," "ดีมาก," "คุณภาพเยี่ยม," "รวดเร็ว").
- The negative lexicon captures dissatisfaction or criticism (e.g., "แย่," "ชำรุด," "ผิดหวัง," "ไม่เหมือนในภาพ").
- Each lexicon entry was assigned a base polarity value (+1 or –1). Polarity adjustments followed Thai-specific linguistic rules:
- Negation reversal for constructions involving "ไม่" (not)
- Intensity multipliers for amplifiers such as "มาก," "ที่สุด," or "สุดๆ"
- Clause-level polarity assignment for sentences joined by contrastive conjunctions (e.g., "แต่")

Three native Thai-speaking annotators with NLP expertise reviewed a stratified sample of 500 reviews to validate lexicon coverage and rule accuracy. Inter-rater disagreements were resolved through consensus, resulting in final lexicons containing 124 positive and 113 negative terms. Coverage testing showed matches in 92.3% of reviews.

THE PROPOSED SENTIMENT-BASED HEART SCORE RECALIBRATION

To address the persistent issue of inflated star ratings in online marketplaces, this study proposes the heart score—a recalibrated metric that more accurately reflects consumer sentiment by integrating textual review content into the rating system. The heart score is constructed through a three-step process:

(1) calculating store-level positive and negative sentiment ratios using a rule-based Thai lexicon model, (2) rescaling the positive sentiment ratio into a core score using normalized linear transformation, and (3) applying a penalty derived from the negative sentiment ratio to account for dissatisfaction.

The result is a linguistically grounded, five-point rating that aligns more closely with the sentiment embedded in user reviews than traditional star ratings.

Step 1: Extracting Store-Level Sentiment Ratios

Sentiment ratios were computed by applying the validated lexicons and polarity rules described in Section 2.3. For each store, the average proportions of sentiment-bearing words classified as positive or negative were calculated. As shown in Table 1, the highest positive sentiment ratio (57.08%) was recorded by SPINNYHOUSE, while the lowest (16.71%) was observed for Nessaj. Negative sentiment ratios also varied, ranging from 1.57% (Nessaj) to 2.89% (wipcloset). These figures highlight variability in the emotional tone of reviews—variability that is not reflected in the narrowly distributed star ratings, which ranged from 4.92 to 5.00.

Table 1. Average Positive and Negative Sentiment Ratios and Star Ratings Across Lazada Stores

Store	Pos%	Neg%	Star Rating
Acaseyshop	43.20	2.76	4.95
BabarryJeans	44.97	1.75	4.99
BEMING.BKK	29.48	2.24	4.97
CHIC.th	47.88	1.83	5.00
Esolo	41.06	2.35	4.98
Giordano	40.82	1.62	5.00
Nessaj	16.71	1.57	4.92
SPINNYHOUSE	57.08	1.85	5.00
wipcloset	50.79	2.89	4.96
Yuedpao	39.60	2.18	4.98

Step 2: Transforming Positive Sentiment into a Core Score

To prevent distortion from extreme values, the positive sentiment ratios were normalized using the mean ± 2 standard deviations, a method widely employed in behavioral, psychometric, and sentiment studies for its balance between sensitivity and robustness. Through this approach, approximately 95% of the distribution is captured while the influence of outliers is reduced.

Using a dataset mean of 41.16% and a standard deviation of 10.21%, the transformation range was defined as [20.74%, 61.58%]. These bounds were then mapped to a target scale of 4.00 to 5.00 using the formula:

Core Score = 4.00 + (Positive Ratio – 20.74)/40.84

For example, CHIC.th's 47.88% positivity resulted in a core score of 4.66 (Table 2), while Nessaj's 16.71% translated into a core score of 3.90. This transformation ensures that vendors with more consistently positive sentiment are scored closer to 5.00 while preserving inter-store variability.

Table 2. Core Scores, Penalty Deductions, and Final Heart Scores Computed from Sentiment Analysis

Store	Core Score	Penalty	HeartScore
Acaseyshop	4.55	0.45	4.10
BabarryJeans	4.59	0.14	4.45
BEMING.BKK	4.21	0.29	3.92
CHIC.th	4.66	0.17	4.50
Esolo	4.50	0.32	4.17
Giordano	4.49	0.11	4.39
Nessaj	3.90	0.09	3.81
SPINNYHOUSE	4.89	0.18	4.71
wipcloset	4.74	0.49	4.25
Yuedpao	4.46	0.27	4.19

Step 3: Subtracting a Penalty for Negative Sentiment

To counterbalance rating inflation and detect subtle dissatisfaction, a penalty derived from the normalized negative sentiment ratio was introduced. Using the same ±2SD normalization method, the bounds for negative ratios were set to 1.27% and 2.94%, based on a mean of 2.10% and a standard deviation of 0.42%. The penalty was scaled to a maximum deduction of 0.50 points and was calculated using the formula:

Penalty Score = [(Negative Ratio – 1.27)/1.67] x 0.50

This method ensures that even small increases in critical sentiment proportionally reduce the final score. For example, CHIC.th's penalty score was 0.17, while Acaseyshop's higher negativity yielded a penalty of 0.45. Nessaj, with relatively low negativity (1.57%), received a minimal penalty of 0.09.

Final Score: The Heart Score

The final heart score for each store was computed by subtracting the penalty from the core score:

Heart Score = Core Score − Penalty Score

As shown in Table 2, CHIC.th, for example, received a final score of 4.66 – 0.17 = 4.50. Acaseyshop's heart score was 4.55 – 0.45 = 4.10, while Nessaj's was 3.90 – 0.09 = 3.81. These final values provide a more realistic and linguistically grounded reflection of each store's review sentiment. Notably, although Nessaj maintains a high star rating (4.92), its heart score falls to 3.81—highlighting the presence of sentiment misalignment and subtle dissatisfaction not captured by traditional ratings.

In summary, the heart score offers a statistically grounded and linguistically interpretable framework for recalibrating inflated e-commerce ratings. By incorporating both positive reinforcement and sentiment-based penalties, this method enables more accurate vendor benchmarking, enhances review

transparency, and supports trust-building mechanisms on digital commerce platforms. The next section applies these recalibrated scores to assess vendor performance across the dataset.

RESULTS AND DISCUSSION

The application of the rule-based sentiment recalibration model to the dataset of 14,877 Thai-language reviews exposed deep structural inconsistencies in the current star rating mechanism. This section presents the empirical findings and analyzes them through a deductive approach, specifically testing the three hypotheses formulated earlier regarding rating inflation, sentiment misalignment, and the efficacy of the proposed recalibration model.

Analysis of Rating Inflation (Testing Hypothesis 1)

The initial analysis confirmed a pervasive "ceiling effect" within the dataset. Despite the diverse range of vendor performance expected in a marketplace, 97.5% of all reviews were assigned a five-star rating. Consequently, the traditional star ratings across the ten sampled stores were compressed into a negligible range of 4.92 to 5.00. This lack of variance renders the star rating effectively useless for comparative benchmarking, as it fails to distinguish between exceptional and merely acceptable service. These findings provide strong empirical support for Hypothesis 1 (The Inflation Hypothesis), confirming that the "J-shaped" distribution predicted by prior literature (Hu et al., 2009) is severely compressed in the Thai context.

Divergence of Sentiment and Score (Testing Hypothesis 2)

In contrast to the static star ratings, significant heterogeneity in consumer experience was revealed through the rule-based sentiment analysis, supporting Hypothesis 2 (The Politeness-Mismatch Hypothesis). Store-level positive and negative sentiment ratios were computed, as shown in Table 1 and visualized in Figure 1.

These ratios revealed substantial variation across stores. For instance, SPINNYHOUSE recorded the highest positivity at 57.08%, followed by wipcloset (50.79%) and CHIC.th (47.88%). In contrast, Nessaj—despite receiving a 4.92-star average rating—had the lowest positivity at just 16.71%. Negative sentiment ratios also varied, ranging from 1.57% (Nessaj) to 2.89% (wipcloset), revealing additional variance in critical feedback. This 40-point spread in positivity indicates that while customers are assigning five stars uniformly, their actual textual praise varies dramatically, confirming the "dual-signal" strategy where high stars mask varied sentiment.

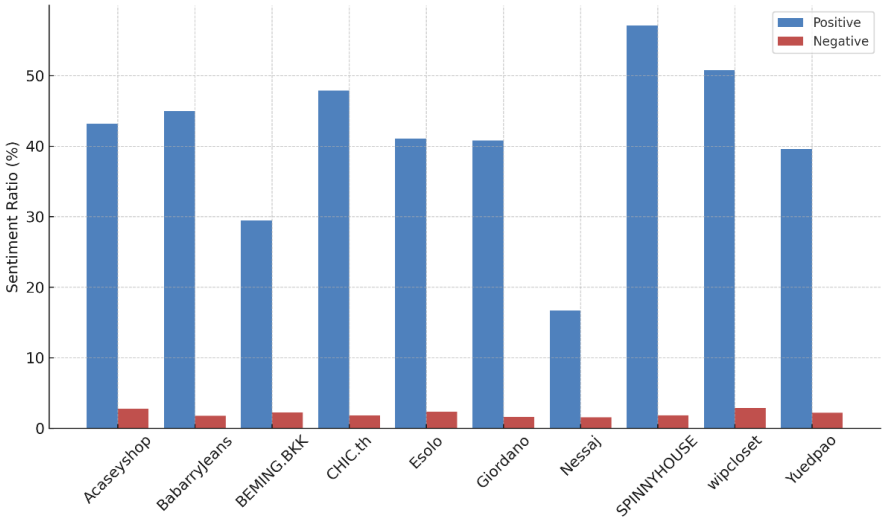

Figure 1. Average Positive and Negative Sentiment Ratios for Each Lazada Store

Efficacy of Recalibration (Testing Hypothesis 3)

To correct this misalignment and test Hypothesis 3 (The Recalibration Hypothesis), these sentiment ratios were translated into the recalibrated Heart Score. This metric combines a Core Score (derived from positive sentiment) and a Penalty Score (reflecting negative sentiment). The resulting values are detailed in Table 2 and visualized in Figure 2.

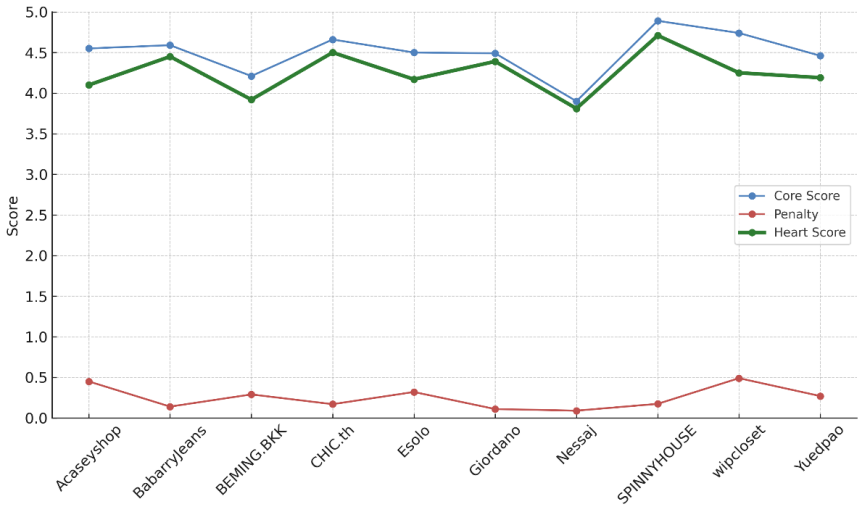

Figure 2. **Core Scores, Penalty Values, and Final Heart Scores Derived from Sentiment Ratios**

The recalibration restored discriminatory power to the rating system. SPINNYHOUSE, which had the highest positive sentiment and low negativity, earned the highest Heart Score at 4.71, closely matching its star rating of 5.00. Conversely, stores such as Acaseyshop, BEMING.BKK, and Nessaj saw substantial drops in their scores. The most critical anomaly appeared with Nessaj, whose minimal positivity (16.71%)

resulted in a Core Score of 3.90 and a final Heart Score of 3.81—the lowest among all vendors. This represents a significant correction from its original 4.92-star rating.

Table 3. Comparison of Original Star Ratings and Recalibrated Heart Scores

Store	Star Rating	HeartScore	Gap
Acaseyshop	4.95	4.1	0.85
BabarryJeans	4.99	4.45	0.54
BEMING.BKK	4.97	3.92	1.05
CHIC.th	5	4.5	0.5
Esolo	4.98	4.17	0.81
Giordano	5	4.39	0.61
Nessaj	4.92	3.81	1.11
SPINNYHOUSE	5	4.71	0.29
wipcloset	4.96	4.25	0.71
Yuedpao	4.98	4.19	0.79

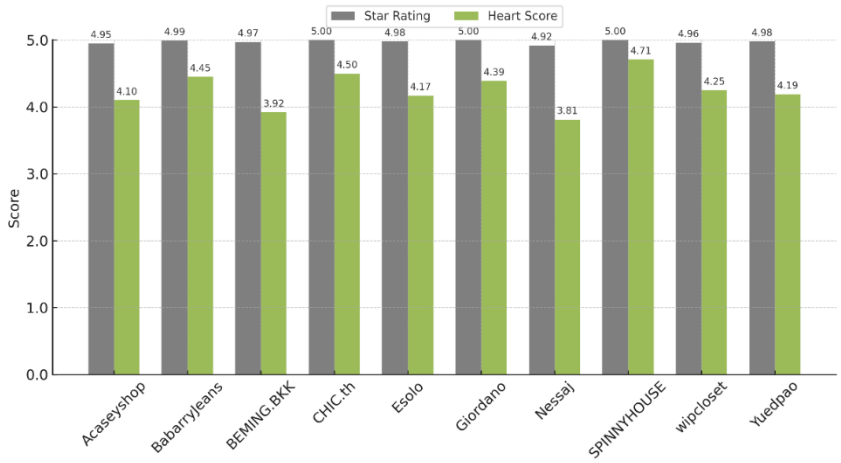

Figure 3. Comparison of Star Ratings and Recalibrated Heart Scores Across Stores

To better understand the disparity between perceived and actual sentiment, the gap between star ratings and Heart Scores for each store was computed. These gaps are summarized in Table 3 and Figure 3.

While star ratings across the ten stores ranged narrowly between 4.92 and 5.00, Heart Scores spanned from 3.81 to 4.71—a broader 0.90 range. The most significant gaps were observed in Nessaj (gap of 1.11), BEMING.BKK (gap of 1.05), and Acaseyshop (gap of 0.85) . These gaps indicate that stores perceived as highly rated based on stars may, in fact, harbor lower satisfaction in review text.

To assist interpretation, the vendors were categorized into three performance tiers based on their Heart Scores:

Excellent (Above 4.49): CHIC.th, SPINNYHOUSE

Very Good (4.00–4.49): Acaseyshop, BabarryJeans, Esolo, Giordano, wipcloset, Yuedpao
Good (Below 4.00): BEMING.BKK, Nessaj

These tiers offer a more transparent and sentiment-consistent classification than conventional ratings. For example, although Nessaj appears highly rated with 4.92 stars, its 3.81 Heart Score places it in the bottom tier—a correction that would be invisible using stars alone.

The divergence between the compressed star ratings and the dispersed Heart Scores confirms the presence of systemic rating inflation, where users assign high ratings despite expressing nuanced or even critical sentiment in their written reviews. The results highlight that sentiment misalignment is not uniformly distributed. Stores like Nessaj and BEMING.BKK received near-perfect star ratings (4.92 and 4.97) despite low positive sentiment ratios, suggesting that traditional ratings can obscure dissatisfaction and provide misleading signals to platform algorithms.

The Heart Score offers distinct advantages for technology management:

1. Increased Sensitivity: Unlike star ratings, which compressed all vendors into a narrow 0.08 range, Heart Scores differentiated performance across a 0.90 range, allowing for more nuanced benchmarking.
2. Interpretability: By leveraging a rule-based model grounded in Thai-language sentiment lexicons, the Heart Score is fully auditable.
3. Contextual Fairness: Vendors with mixed or critical feedback are fairly penalized, ensuring that reputational scores reflect the deeper sentiment context rather than just surface-level clicks.

In conclusion, the recalibrated Heart Scores provided greater sensitivity, better differentiation, and stronger alignment with consumer sentiment than traditional ratings. By integrating sentiment-based metrics, platforms can mitigate the effects of rating inflation and build more robust, transparent trust mechanisms.

CONCLUSION

This study addressed the systemic challenge of rating inflation within the Southeast Asian e-commerce ecosystem by introducing the Heart Score, a sentiment-based recalibration framework designed for Thai-language consumer reviews. While numerical star ratings function as the dominant trust mechanism on platforms like Lazada, our analysis confirmed that they frequently fail to capture the nuance of user experience, creating a significant disconnect between quantitative scores and the qualitative reality of textual feedback. This misalignment is intensified in culturally specific contexts such as Thailand, where communication norms favoring indirectness and politeness often mask critical sentiment under high nominal ratings.

To bridge this gap, a transparent, rule-based sentiment analysis model tailored to the linguistic characteristics of the Thai language was developed. By extracting store-level positive and negative sentiment ratios and applying a statistically normalized linear transformation with penalty adjustments, the Heart Score was successfully derived. The application of this metric revealed that, while traditional star ratings were compressed into a near-uniform distribution (4.92–5.00), discriminatory power was restored through the Heart Score, effectively distinguishing vendors with genuinely high satisfaction from those exhibiting “hidden” dissatisfaction. Vendors receiving consistently positive textual feedback were validated, whereas those with mixed sentiment were subjected to appropriate score moderation.

Managerial Contributions

The proposed framework offers significant contributions to technology management in digital marketplaces, specifically through algorithmic governance. By providing a more accurate signal for vendor benchmarking, the Heart Score allows platforms to move beyond simple arithmetic means and rank products based on verified sentiment rather than inflated clicks. This enables managers to identify "hidden churn"—customers who leave high ratings out of politeness but are unlikely to repurchase due to unresolved issues. Furthermore, unlike opaque "black box" machine learning models, the rule-based approach ensures transparency and interpretability—critical features for maintaining seller trust. Adopting such sentiment-verified metrics can also serve as competitive trust signals, differentiating vendors whose reputation is backed by linguistic analysis.

Policy Implications

Beyond platform management, the findings hold significant implications for policymakers regarding digital consumer protection. Regulatory bodies should consider rating inflation as a potential form of misleading commercial practice; policies encouraging the disclosure of sentiment distributions alongside star ratings would protect the "Right to Accurate Information." Additionally, as the digital economy grows, policymakers must advocate for "Explainable AI" in reputation systems, using transparent models like the Heart Score as a blueprint for auditability. For international platforms operating in Southeast Asia, this research underscores the necessity of culturally calibrating reputation metrics to ensure fair competition and informed consumer choice.

While this study validated the methodology within the women's clothing category on Lazada, the underlying logic is transferable to other product domains and linguistic contexts, provided that sentiment lexicons are appropriately localized. Future research should therefore explore several important directions. One avenue involves the development of hybrid modeling approaches that integrate the interpretability of rule-based techniques with the predictive flexibility of machine learning, enabling the handling of more complex linguistic patterns. Another promising direction lies in the expansion of sentiment lexicons through semi-supervised learning or domain adaptation methods, which would enhance coverage across additional product categories and strengthen model robustness. A further direction concerns cross-cultural validation, in which the Heart Score framework is applied to multilingual or multi-market datasets to examine how rating–sentiment misalignment differs across cultural and linguistic environments.

In conclusion, this research presents a scalable and language-sensitive solution to the problem of rating inflation. By offering a transparent and interpretable method for recalibrating user ratings, the Heart Score provides practical value for consumers, sellers, and platform operators navigating the complexities of trust and credibility in the digital economy.

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THE IMPACT OF FINANCIAL STABILITY AND ECONOMIC GROWTH ON FINANCIAL INCLUSION IN THE COMESA REGION

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ABSTRACT

There has been an increasing amount of research in recent years on the moderating roles of financial market development, institutional quality, financial stability and economic growth on financial inclusion. However, there remains a dearth of research on the Common Market for Eastern and Southern Africa (COMESA) region, compared to other economic blocs like Sub-Saharan Africa (SSA), the Southern African Development Community (SADC), and the Economic Community of West African States (ECOWAS), largely due to data paucity, a lack of interest among active scholars, and the heterogeneity of economies in the region. Yet these differences are further reasons we should engage in scholarly research, which informs practice and policy changes with real-world impact on previously excluded communities. This study investigates the impact of financial stability and economic growth on financial inclusion in the COMESA region, utilising panel data from 2007 to 2022 and employing a two-step system GMM estimation method. Financial inclusion and financial stability in this study are measured using a composite index derived from principal component analysis (PCA). We found that the lag of financial inclusion, financial stability and economic growth exert a positive and significant impact on financial inclusion in the region. Among the considered control variables, the findings revealed that domestic credit to the private sector and the real interest rate both have a positive impact, while mobile subscriptions, institutional quality, and income inequality have a negative impact on financial inclusion in the region. This study recommends that policymakers implement financial market reforms to facilitate greater financial inclusion by lowering the cost of mobile data access and mandating that all state banks establish low-cost bank accounts with savings and transactional capabilities. To increase intra-trade amongst member states, we recommend easing import and export customs and excise duties, as well as similar tariffs, on services rendered by and goods manufactured or produced by MSMEs, in line with the provisions of the African Continental Free Trade Area (AfCFTA) agreement, leading to productive cross-border investments, regional integration, increased trade and economic growth.

Keywords: *Financial inclusion, Financial stability, Economic growth, COMESA, Principal Component Analysis, System GMM*

INTRODUCTION

Financial inclusion has garnered significant attention globally, particularly in research areas, government policies, and the financial sector, as it is one of the primary catalysts for achieving economic and social growth. Financial inclusion also helps to meet the goals of long-term strategies (SDGs and African Union Agenda 2063**)**; in addition, it has measurable relevance, enhancing the financial system,

boosting the proportion of income, and allowing funds to flow from individuals or companies with excess resources to those having a shortage (Claessens & Perotti, 2007; World Bank, 2014; Sethi & Acharya, 2018; Makina & Walle, 2019). In short, financial inclusion deals with a system of allowing access and providing formal financial services to the excluded individuals timely and affordable prices (Ozili, 2018b). Despite extensive empirical findings confirming the importance of financial inclusion, it continues to be affected by different macroeconomic and micro-level factors.

The possible factors of financial inclusion have been extensively examined by numerous scholars across different research areas, especially in developing regions (Beck et al., 2006; Demirguc-Kunt & Klapper, 2012; Allen et al., 2016; Chikalipah, 2017; Asuming et al., 2018; Gebrehiwot & Makina, 2019; Bashiru et al., 2023; Eshun & Kočenda, 2025). However, there is no agreement on the primary factors influencing financial inclusion, as these factors differ significantly depending on the specific context of each country. In contrast, to realize a benefit from financial inclusion, clearly identifying and taking action on the main factor is required. Therefore, in this paper, we exclusively examine the impact of financial stability and economic growth on financial inclusion. The findings of this study will be particularly helpful for policymakers by focusing on only these two determinants.

Financial stability can be defined as the financial system's ability to facilitate and improve economic activities, analyze and manage risks, and absorb shocks; and the state of financial stability is continuously changing over time, showing dynamic behavior (Schinasi, 2004; Allen & Wood, 2006; Morgan & Pontines, 2018). The interaction between financial inclusion and financial stability mainly falls into two contradicting views. The first view argues that financial inclusion enhances financial stability; for instance, increasing access to and use of financial services for SMEs will increase bank deposits, diversify credit and risk, and enhance social integrity. The other view, financial inclusion affects financial stability by increasing financial service costs and risks of credit default (Mehrotra & Yetman, 2015; Čihák et al., 2016).

On the other hand, financial stability could hinder financial inclusion by prioritising profit growth and avoiding high-risk customers. Conversely, the presence of financial stability can foster confidence in the financial system, leading to increased use of financial services or products (Mehrotra & Yetman, 2015). This inconclusive finding highlights the need for further investigation, particularly in regions such as COMESA.

Furthermore, as the findings of studies conducted by Cámara and Tuesta (2014), Gebrehiwot and Makina (2019), and Oumarou and Celestin (2021) indicate, economic growth is a key macroeconomic determinant of financial inclusion. Financial inclusion expands when there is adequate job opportunity, raises per capita income and increased profitability of business, but all of these are realized when the economy is growing. Economic growth enhances households' demand for financial services, thereby increasing the financial sector's capacity. suggesting that economic growth and financial inclusion support each other. However, these relationships are not always true. Therefore, it is crucial to investigate the influence of economic growth on financial inclusion within the regional context.

It has been witnessed that there is still a substantial gap in the financial inclusion level of COMESA member countries (Demirgüç-Kunt et al., 2022). This observation further confirmed the presence of key factors which affect the ongoing financial inclusion practice in this economic bloc. Additionally, different researches were conducted to explore the macro-economic determinants of financial inclusion in other economic regions (Gebrehiwot & Makina, 2019; Wokabi & Fatoki, 2019; Mhlanga & Denhere, 2020). Others analyzed the role of institutional quality to inclusive finance in Africa (Nsiah & Tweneboah, 2023). COMESA is an economic bloc that brings together 21 member states to promote regional integration, trade expansion, and sustainable economic development. Despite progress in regional cooperation, many COMESA countries continue to face challenges related to inter alia, financial instability, slow economic

growth, shallow financial markets, poor institutional quality, and low levels of financial inclusion. This paper thus acknowledges the important role that COMESA countries play on a larger scale, particularly in economic trade and integration within Africa. This, therefore, underscores the need for documented research on the region. To achieve this aim, identifying and examining the main macro determinants of financial inclusion is critically important, as it enables greater trade and intermediation across the region. Additionally, a stable financial system and economic growth are the primary requirements for households and entrepreneurs to participate in trade and investment projects in the region. By examining how financial stability and economic growth affect financial inclusion in this diversified economic bloc, this study offers original, empirical findings that will provide invaluable contribution to the policy makers in COMESA, where there are attempts at financial integration in the region Thus, the ongoing dynamics of the financial inclusion level, the presence of ambiguous findings, and the lack of thorough regional and national studies regarding the impact of financial stability and economic growth on financial inclusion are the main motivational factors for implementing this overlooked research topic in the COMESA region.

Generally, we employ a two-step system, the Generalised Method of Moments (GMM), to estimate the impact of financial stability and economic growth on financial inclusion, with a focus on COMESA. Financial inclusion and financial stability are measured by indices constructed using PCA. Our study findings reveal that lagged financial inclusion, financial stability, and economic growth are the main drivers that facilitate financial inclusion in the study area. Thus, this study suggests that policymakers in the region should focus on creating a stable financial system and investing in projects that enhance economic growth, thereby improving financial inclusion levels.

The remainder of the paper is structured as follows. Section 2 presents a relevant literature review. Section 3 discusses the data sources and methodology aspects. Section 4 discusses empirical results, and Section 5 provides a summary, conclusions and policy implications.

LITERATURE REVIEW

Financial intermediation theory relates the expansion of financial services to the role of financial sectors. According to this theory, financial sectors play a significant role in mobilizing savings, providing credit and decreasing information asymmetry. This means that financial inclusion can be improved through the active practices of the formal financial sector. This intermediation role is facilitated by a stable financial system, which strengthens the confidence of households and small businesses, enabling financial sectors to offer loans. A stable financial system helps. From these perspectives, financial stability is a crucial enabler of financial inclusion, as stable financial sectors are better equipped to expand financial services and develop new or innovative products that are user-friendly. Thus, this theory lends support to the arguments that financial stability promotes financial inclusion.

The demand-following and supply-leading theory explains the relationship between financial inclusion and economic growth. The demand-following hypothesis states that when a given economy expands, the financial system will improve consequently (Robinson, 1952). In other words, when economic activities improve, the need for financial services and products also increases, which motivates financial institutions to provide the required services tailored to the demands of households and firms. On the other hand, the financial sector expands the services it provides to underprivileged groups in society as economic growth boosts the sector's capacity through increased deposit and investment opportunities. Thus, this expansion leads to increased financial inclusion.

The other contrasting supply-leading view states that financial development has a positive effect on economic growth (Schumpeter, 1911; Patrick, 1966). Supporting the idea of Schumpeter, other scholars also discussed the significance of financial inclusion for economic growth via capital accumulation

(Goldsmith, 1969; McKinnon, 1973; Shaw, 1973; King & Levine, 1993; Levine, 2005). More importantly, theoretical studies and plenty of empirical evidence showed that the presence of a significant and positive connection between the financial system and the expansion of the economy (Levine, 2005). Therefore, the demand-following and supply-leading theory provides a theoretical foundation for examining how economic growth impacts the demand and supply sides of financial inclusion.

Financial inclusion is also linked positively with economic expansion, at least in two ways: (a) by offering financial services at low cost to poor people, it helps improve their livelihood. This means that low-income individuals can engage in small-scale businesses, thereby becoming economically independent and contributing to aggregate economic growth. (b) The other way is by promoting saving and insurance services; inclusive finance can increase funds available in the financial sector to be utilized for investment and reduce liquidity problems (Sethi & Sethy, 2019).

Past studies promoted the widely accepted mechanism in which financial structure helps to accelerate economic growth (Goldsmith, 1969; McKinnon, 1973; Shaw, 1973). In this view, financial intermediation plays a pivotal role in economic growth, as it ensures that financial resources are efficiently allocated to boost economic activity, taking into account information asymmetry (Levine et al., 2000). The presence of effective financial intermediation allows access to financial services, especially for disadvantaged populations, thereby promoting inclusive economic growth. This means that by widening access to financial services for firms and individuals, it is possible to solve their financial constraints and consequently enhance the productivity of firms and secure individual welfare. Numerous studies also proved the positive influence of financial inclusion on economic growth (Levine, 2005; Demirgüç-Kunt et al., 2017; Kim et al., 2018; Sethi & Acharya, 2018; Makina & Walle, 2019).

Similarly, access to financial services helps to minimize inequality and poverty (Beck et al., 2007; Honohan, 2004; Omar & Inaba, 2020; Karakara et al., 2025). Conversely, lack of access to formal financial services creates obstacles to entrepreneurship, investments and innovations in a given economy; consequently, firms facing financial constraints will experience limited growth and productivity, which in turn affects the aggregate economic growth (Claessens & Perotti, 2007).

Additionally, the endogenous growth theory is recalled, where the economic growth model considers the role of capital in innovative works, which includes investments in innovative and intellectual capital and knowledge and skills (Romer, 1986; Lucas, 1988; Chirwa & Odhiambo, 2018). Previous empirical findings showed that financial inclusion enhances economic growth through the moderating role of human capital, which agrees with endogenous growth theory, where productivity depends on innovation and human capital investment (Matekenya et al., 2021 Thathsarani et al., 2021; Boachie & Adu-Darko, 2024; Pham et al., 2025). Moreover, the role of financial technologies in Africa, for instance, mobile money in Kenya (i.e., M-PESA) for improving financial inclusion, is widely understood from earlier studies (Van Hove & Dubus, 2019; Ha et al., 2025). More recently, Oyedotun and Makoni (2026) averred that financial technologies (fintech) also significantly reduce transaction costs and enhance access to financial services for households and firms.

Scholars also categorized the link between financial inclusion and financial stability into two broad categories, in which the majority of them support that inclusive finance supports financial stability, while some argue that financial inclusion enhances financial instability (Damane & Ho, 2024). The positive influence of financial inclusion on financial stability is supported by institutional theory (Meyer & Rowan, 1977; DiMaggio & Powell, 2000). Moreover, financial inclusion practices should be accompanied by a strong financial sector regulation and supervision strategy to achieve a stable financial system. In a similar argument, financial inclusion cannot be realized without the presence of financial stability, and conversely financial stability cannot be achieved if there is a large portion of society which is financially excluded (Khan, 2011). Other studies also discussed synergies between financial inclusion and financial stability can

be generated in the presence of an enabling regulatory framework, lower transaction costs and technological innovations (Hannig & Jansen, 2010; Khan, 2011; Oyedotun & Makoni, 2026). In the presence of high institutional quality, the practice of inclusive finance has a favorable effect on financial stability (Han & Melecky, 2013; Morgan & Pontines, 2014; Ahamed & Mallick, 2019; Le et al., 2019; Hakimi et al., 2022; Antwi et al., 2024; Golpet et al., 2026). In a similar concept, enhanced financial inclusion practice requires the existence of regulatory and supervisory frameworks (Vo et al., 2021; Wang & Luo, 2022; Sethy & Goyari, 2022; Ha & Nguyen, 2023; Koudalo & Toure, 2023).

The negative influence of financial inclusion on financial stability mainly arises due to aggressive financial inclusion practices, which result in information asymmetry, increased financial service costs, and risks of credit default during attempts to reach out to the deprived individuals and firms found in new and remote locations (Mehrotra & Yetman, 2015; Sahay, 2015; Čihák et al., 2016). A previous study reported that fast expansions in credit are often precursors to financial crises (Schularick & Taylor, 2012). In addition, the practice of excessive inclusive finance may lead to adverse selection and moral hazard issues, as the underserved portion of the population often lacks a credit history and collateral requirements (Saha & Dutta, 2021; Kebede et al., 2024).

On the other hand, financial stability can increase people's confidence in the financial system, which will improve financial inclusion (Mehrotra & Yetman, 2015) and the probability that people will utilize formal services (Beckmann & Mare, 2017). A study was conducted to examine the relationship between financial inclusion and financial stability, applying a sample of 42 Asian countries in three individual years: 2011, 2014, and 2017 (Pham & Doan, 2020). The study measured financial inclusion by access to and usage of financial services, while financial stability is indicated by the bank z-score. The study employed fixed effects and random effects regression to model the influence of financial inclusion on financial stability. Moreover, the study also adopted Feasible Generalized Least Squares (FGLS) regression for the random effect regression purpose. The findings of the empirical analysis revealed a positive influence of financial inclusion on financial stability.

Noting the presence of underperforming financial intermediaries, poor institutional quality, high non-performing loans, and a fragile financial system in Africa, it is necessary to understand whether the ongoing financial inclusion policies promote the soundness of the banking structure or cause financial instability (Beck et al., 2013). Moreover, the benefits of access to financial services for enterprises and households depend on the existing institutional quality. Hence, financial inclusion practices also satisfy financial stability in the presence of strong financial system regulation and a supervision body, which is guided by the institutional theory (Meyer & Rowan, 1977; DiMaggio & Powell, 2000). On the other hand, excessive emphasis on financial stability may also endanger financial inclusion by facilitating involuntary financial exclusion. In this case, financial institutions restrict access to financial services for the deprived people during the regulatory action aimed at enhancing their returns and reducing risks (Čihák et al., 2020).

Based on the foregoing exposition of existing literature, it is evident that there are knowledge gaps insofar as research on financial stability and financial inclusion is concerned, focusing on small but important economic blocs such as COMESA. As such, this current study seeks to complement the literature on these key concepts by providing insights into the importance of financial stability in driving further economic growth and spurring financial inclusion in integrated markets within the COMESA region. This is necessary to provide a basis for policy formulation, action research, and to actually convince financially excluded communities of the benefits of being integrated into financial systems, both as individuals and as small businesses.

DATA AND EMPIRICAL MODEL

Data and variables

To investigate the impact of economic expansion and financial stability on financial inclusion, a balanced panel dataset comprising 17 COMESA member countries for the 2007-2022 study period has been employed. However, due to data unavailability in our study area, we are able to consider only 17 members out of the 21 member countries of the COMESA region. The choice of the panel data set mainly depends on the availability of data in the study area. The data for the study variables are obtained mainly from World Development Indicators (WDI), International Financial Statistics (IFS), Global Financial Development (GFD), and Financial Access Survey (FAS) IMF databases.

The dependent variable in this study is financial inclusion, which is measured by a composite index constructed using principal component analysis. The main explanatory variables identified in this analysis are thus financial stability and economic growth, respectively. The financial stability index comprises bank Z-score, bank credit to bank deposit and liquid assets to deposits and short-term funding. Economic growth is represented by GDP per capita (in constant 2015 US dollars). These measurements and proxies have also been discussed in several studies (Sarma & Pais, 2011; Evans & Adeoye, 2016; Uddin et al., 2017; Gebrehiwot & Makina, 2019; Bashiru et al., 2023; Tou & Diarra, 2025).

Additionally, control variables have been considered to better explain the impact of economic growth and financial stability on financial inclusion. The control variables are domestic credit to the private sector (DCTP), real interest rate, mobile subscription, government expenditure, institutional quality index, inflation rate, income inequality, and rural population growth rate. We expect the positive impact of economic growth and financial stability on financial inclusion in the COMESA region. A detailed description of variables is presented in Appendix A.

The multidimensional behavior of financial inclusion, financial stability and institutional quality requires an index, evaluated using Principal Component Analysis (PCA), to avoid multicollinearity and measurement errors and obtain robustness in estimation (Sarma, 2016). The financial inclusion index calculated herein basically considers geographic, demographic and usage dimensions (Singh & Stakic, 2020; Kebede et al., 2021). Likewise, the study considers two indicators for geographic penetration (number of ATM per 1000km^2 and number of bank branches per 1000km^2); three indicators for demographic penetration (number of ATM per 100,000 adults (NATMAD), number of bank branches per 100,000 adults (NBBAD)) and two indicators for bank usage dimension (outstanding loans (OUL) and outstanding deposits (OUD) as percentage of GDP).

Principal component analysis

The procedures followed to calculate financial inclusion using PCA are discussed below. Before constructing the composite index, in the first stage, we have normalized the data using the min-max method, and then we proceed with PCA.
In the first stage, PCA indices for the three financial inclusion indicators were estimated using the following formula (1).

$$\begin{aligned} FI_{geo} &= \gamma_1 NATMA + \gamma_2 NBBA; \\ FI_{demo} &= \beta_1 * NATMAD + \beta_2 * NABBAD + \beta_3 NBACC; \\ FI_{usa} &= \mu_1 * OUD + \mu_2 * OUL \end{aligned} \tag{1}$$

Where *FI_geo, FI_demo* and *FI_usa are calculated indices for* geographic, demographic and bank usage dimensions of financial inclusion. NATMA refers Number of ATM per 1000 km^2area, NBBA means Number of bank branches per 1000 km^2area, NATMAD represents the Number of ATMs per 100,000 adults, NBBAD refers Number of bank branches per 100,000 adults, NBACC refers Number of bank accounts per 1000 adults, OUD means Outstanding deposits as a percentage of GDP, and OUL refers to Outstanding loans as a percentage of GDP.

In the second stage, the overall financial inclusion index has been estimated by employing the indices obtained from each dimension in stage 1. Accordingly, the following estimation equation (2) has been used.

$$FII = \alpha_1 FI_{geo} + \alpha_2 FI_{demo} + \alpha_3 FI_{usa} \quad (2)$$

where FII refers to the financial inclusion index, *FI_geo, FI_demo* and *FI_usa* are constructed indices of geographic penetration, demographic penetration and bank usage dimensions of financial inclusion from the corresponding indicators

Similarly, the indexed value for financial stability has been determined based on the bank's Z-score, bank credit to bank deposits, and liquid assets to deposits and short-term funding measures of stability. The following estimation model (3) has been used to construct an index for financial stability.

$$FSI = \alpha_1 Zscore + \alpha_2 BCBD + \alpha_3 LATDS \quad (3)$$

where *Z-score* represent bank z-score, *BCBD* stands for bank credit to bank deposit (%), and *LATDS* is liquid assets to deposits and short-term funding (%).
Finally, the institutional quality index has been evaluated using first-stage PCA. Institutional Quality Index) can be evaluated using Equation (4).

$$IQIN = \beta_1 * COC + \beta_2 * GEF + \beta_3 * PSA + \beta_4 * RQL + \beta_5 * ROL + \beta_6 VOA \quad (4)$$

where control of corruption (COC), government effectiveness (GEF), regulatory quality (RQL), the rule of law (ROL), voice and accountability (VOA), and political stability and absence of violence (PSA). The IQIN evaluated from PCA is further normalized to obtain values between 0 and 1.

Empirical model specification

The primary objective of this study is to investigate the impact of financial stability and economic growth on the level of financial inclusion in the COMESA region. This aim is also motivated by the demand-following hypothesis, which argues that the presence of economic expansion promotes the need for financial services (Robinson, 1952).
To achieve this aim, the system GMM estimation approach has been applied (Blundell & Bond, 1998). Moreover, a two-step system GMM estimator is preferred over a one-step system GMM method since it takes into account endogeneity and heteroskedasticity issues (Arellano & Bond, 1991; Blundell & Bond, 1998). The empirical model specified in levels and first difference, as shown in equations (5) and (6), has been employed. As it can be clearly understood from the equations, the current level of financial inclusion ($FI_{i,t}$) depends on the lag of financial inclusion ($FI_{i,(t-1)}$) and other macroeconomic determinants.

$$FII_{it} = \beta_o + \beta_1 FII_{it-1} + \beta_2 FSI_{it} + \beta_3 lnGDPPC_{it} + \sum_{j=1}^{p} \partial_j X_{it} + \eta_i + \xi_t + \varepsilon_{it} \quad (5)$$

$$\Delta FII_{it} = \beta_1 \Delta FII_{it-1} + \beta_2 \Delta FSI_{it} + \beta_3 \Delta lnGDPPC_{it} + \sum_{j=1}^{p} \partial_j \Delta X_{it} + \Delta \xi_t + \Delta \varepsilon_{it} \quad (6)$$

where *FII* is the dependent variable, representing the financial inclusion index. Likewise, *FSI* represents the Financial Stability Index, and lnGDPPC is the natural logarithm of GDP per capita, which serves as a proxy for economic growth. *X* is a set of control variables. η_i is a constant term for country-specific effect; ξ_t is a constant for time-specific, and ε_{it} is an error term. The Akaike Information Criterion (AIC) has been used to determine the suitable lag time. In some cases, the maximum number of lags should be restricted to avoid overfitting problems.

The validity of the applied instruments has been checked using Sargan and Hansen tests used for Over-Identification Restrictions (OIRs). The AR (2) test has been employed to check whether the residuals are free from second-order autocorrelation. The Difference-in-Hansen Test (DHT) is used to check the exogeneity of instruments in the model. The Fisher test has been implemented to check the joint validity of the estimated coefficients.

Moreover, robustness has been checked by comparing the prediction results of system GMM with those of OLS and FE prediction values. In addition, the OLS and FE predictions can still be used as a benchmark to evaluate whether the dynamic panel system GMM predictions are consistent or not (Mahembe & Odhiambo, 2021). The coefficient of the lagged dependent variable (i.e., financial inclusion) should be less than unity and found between the OLS and FE predictions. Therefore, the reliability of the system GMM model is assured if the coefficient of the lagged dependent variable (i.e., financial inclusion) is between the OLS and FE predictions.

Additionally, if the lagged dependent variable has a positive and significant coefficient, then the financial inclusion exhibits persistence behavior. Consequently, the application of a dynamic panel system GMM prediction is acceptable.

RESULTS AND DISCUSSIONS

Summary of statistics

Table 1 presents the summary of descriptive statistics (mean, standard deviation, minimum and maximum values) of each variable are discussed below. As shown below, the maximum and minimum values of the three composite indices (i.e. FII, FSI and IQIN) have values between 0 and 1 since they are normalized using the min-max normalization method. As the findings demonstrate, financial stability and economic growth vary significantly among countries, with financial stability ranging from 0 to 1 and economic growth ranging from 5.57 to 9.73. This variation generally suggests that the COMESA region has diverse economic and financial systems, which may result in varying levels of financial inclusion across the region, highlighting the importance of examining the impact of financial stability and economic growth on financial inclusion.

Table 8: Summary statistics

Variable	Obs	Mean	SD	Min.	Max.
Financial inclusion index	272	0.28	0.25	0	1
Financial stability index	272	0.43	0.21	0	1
Economic growth	272	7.39	1.16	5.57	9.73
Domestic credit to private sector as % of GDP	272	26.57	23.27	2.65	105.00
Mobile subscription	272	72.60	45.26	1.47	206.70
Real interest rate	272	6.97	15.046	-81.13	52.44

Government expenditure as % of GDP	272	17.40	7.83	2.05	50.84
Institutional quality index	272	0.41	0.26	0	1
Rural population growth rate	272	1.56	1.11	-3.71	4.78
Inflation rate	272	2.47	1.12	-1.76	7.02
Income inequality	272	43.10	6.86	32.50	60.20
Note: the abbreviations SD- Standard Deviation; Min- Minimum; Max- Maximum. Source: - Source: authors' own computations					

Composite index development

The multidimensional nature of financial inclusion, financial stability, and institutional quality necessitates considering a composite index in their associated measurement approach. Moreover, using individual indicators may provide limited information and may lead to inaccurate conclusions (Gupte et al., 2012; Sarma, 2016). Additionally, using multiple correlated indicators in a single equation may lead to multicollinearity (Huni et al., 2025). To overcome these issues, the most recent works suggest creating a composite index. Thus, this study constructs composite indices for financial inclusion and financial stability, considering seven and three measures, respectively. The results of the PCA are presented in Appendix B.

Empirical findings on the effect of financial stability and economic growth on financial inclusion

Unit root test results

The order of integration of each variable has been tested employing both first- and second-generation unit root tests from the first generation, we used Levin Lin Chu (LLC), Im, Pesaran and Shin (IPS) and Cross-sectionally Augmented Im-Pesaran-Shin (CIPS), Cross-sectionally Augmented CADF from the second-generation unit root tests**.** The tests have been carried out in three ways: 1) with no intercept and trend; 2) with intercept; and 3) with intercept and linear trend. The results have been presented below in the table. Based on the result below, we conclude that there is a mixed order of integration in the data set, but none of the variables is integrated at I(2). Thus, this ensures that the dataset is compatible with a dynamic panel estimation, such as system GMM.

Table 9 panel unit root tests

		First generation				**Second Generation**			
Variables	**Levels**	**Levin Lin Chu (LLC)**		**Im, Pesaran and Shin (IPS)**		**Cross-sectionally Augmented Im-Pesaran-Shin (CIPS)**		**Cross-sectionally Augmented CADF**	
		I(0)	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**
FII	None	1.52	-1.67***						
	Constant	0.08	-7.95***	-0.29	-7.03***	-0.77	-3.75***	-1.37	-3.75***
	Constant and trend	-4.46***	-6.68***	-2.55***	-7.72***	-1.89	-4.02***	-2.11	-4.02***
L. FII	None	2.22	-11.15***						

	Constant	0.19	-6.41***	-0.48	-6.57***	-0.95	-3.57***	-1.41	-3.57***
	Constant and trend	-5.35***	-5.86***	-2.87***	-6.93***	-1.92	-3.72***	-2.25	-3.72***
FSI	None	-1.35	-12.18***						
	Constant	-3.69***	-5.85***	-2.12**	-7.92***	-2.73***	-4.26***	-2.76***	-4.29***
	Constant and trend	-5.51	-5.22***	-3.89***	-8.13***	-3.46***	-4.21***	-3.37***	-4.21***
LnGDPPC	None	4.86	-5.02***						
	Constant	-3.38***	-4.89***	-0.43***	-6.29***	-2.14	-3.24***	-1.82	-3.052***
	Constant and trend	-3.34***	-5.89***	-1.97*	-6.71***	-2.75***	-3.51***	-2.25	-3.10***
INFR	None	-4.67***	-20.14***						
	Constant	-8.86***	-13.83***	-4.26***	-7.77***	-2.70***	-4.39***	-2.41***	-4.04***
	Constant and trend	-7.92***	-13.83***	-5.26***	-7.73***	-3.35***	-4.14***	-2.84**	-4.08***
DCTP	None	2.59	-7.28***						
	Constant	2.45	-4.21***	1.87	-6.06***	-1.48	-3.05***	-1.48	-3.18***
	Constant and trend	-1.24	-4.54***	-1.12	-6.93***	-1.87	-3.48***	-1.87	-3.48***
MSUB	None	4.39	-6.09***						
	Constant	-4.45***	-4.71***	-1.54*	-5.42***	-2.21*	-2.99***	-1.93	-3.00***
	Constant and trend	-4.30***	-4.54***	-1.65*	-6.19***	-2.47	-3.14***	-2.25	-3.14***
IQIN	None	-1.71**	10.20***						
	Constant	-3.81***	-5.39***	-0.15	-6.79***	-1.26	-3.41***	-1.26	-3.30***
	Constant and trend	-3.09***	-5.22***	-2.17*	-7.01***	-1.94	-3.59***	-1.94	-3.45***
GEXP	None	0.48	-11.31***						
	Constant	-4.48***	-5.50***	-1.65*	-7.42***	-1.77	-3.70***	-1.77	-3.71***
	Constant and trend	-5.65***	-4.03***	-4.08***	-7.38***	-2.26	-3.76***	-2.26	-3.76***
RUPOP_gr	None	-7.30***	-5.26***						

	Constant	-1.05	-12.40***	4.7	-4.99***	-2.48**	-3.31***	-1.32	-3.19***
	Constant and trend	-7.78***	-12.08***	-1.65**	-4.93***	-2.81**	-3.20***	-2.42	-3.20***
RIR	None	-1.0565	-19.32***						
	Constant	-3.62***	-13.422***	-4.12***	-8.57***	-2.883***	-4.695***	-2.035	-3.057***
	Constant and trend	-9.074***	-13.56***	-5.76***	-8.92***	-3.265***	-4.641***	-2.412	-3.389***
*Note that: ***, ** and * represent a 1%, 5% and 10% significant level respectively*									

To examine the impact of financial stability and economic growth on financial inclusion in the COMESA region, a two-step system GMM regression estimator is adopted. OLS and fixed-effect models are estimated as robust economic models. The variables Domestic credit to private sector, Mobile subscription, real interest rate, government expenditure, institutional quality index, inflation rate, Income inequality and Rural population growth rate are considered as control variables. The result of the two-step system GMM in the

Table 10 have advocated that both financial stability and economic growth have a positive impact on financial inclusion in the region.

Table 10 The impact of financial stability and economic growth on financial inclusion in COMESA

	Dependent variable: Financial inclusion (FII)		
VARIABLES	**SGMM**	**OLS Model**	**FE Model**
Lagged financial inclusion (FII)	0.621***	0.806***	0.579***
	(0.138)	(0.036)	(0.091)
Financial stability Index	0.159***	0.031	0.034
	(0.052)	(0.029)	(0.046)
lnGDPPC	0.044***	0.020**	-0.026
	(0.01)	(0.01)	(0.045)
Domestic credit to private sector	0.003**	0.002***	0.002***
	(0.001)	(0.000)	(0.000)
Mobile subscription	-0.0003**	-0.0002	-4.88e-05
	(0.000)	(0.000)	(0.000)
Real interest rate	0.0005**	0.0005**	0.00054*
	(0.000)	(0.000)	(0.000)
Government expenditure	0.0000	0.000122	0.00143**
	(0.0006)	(0.000510)	(0.000639)
Institutional quality index	-0.040*	-0.0322	0.0689
	(0.0211)	(0.0197)	(0.0681)
Inflation rate	0.0015	-0.00105	-0.00218
	(0.0038)	(0.00339)	(0.00393)
Income inequality	-0.0022**	-0.000276	0.0088

	(0.001)	(0.0007)	(0.006)
Rural population growth rate	0.0078 (0.0057)	0.0087* (0.0052)	0.0049 (0.0062)
Constant	-0.2401*** (0.065)	-0.134** (0.063)	-0.196 (0.356)
Observations	255	255	255
R-squared		0.958	0.506
Number of ID	17		17
AR(1)	0.0310		
AR(2)	0.596		
Hansen	0.463		
Sargan	0.249		
DHT	0.288		
Number of Instruments	15		
Fisher	4290***	499***	166***

*Note: The variables are measured on yearly bases. ***, **, and * indicate a 1%, 5% and 10* significant level respectively. The t-statistics are in parentheses. The estimation is conducted using a dynamic panel two-step system GMM estimator (via the xtabond2 Stata command) with Windmeijer's (2005) finite-sample correction and the equation-level option. A maximum of 1 lag is used for the dependent and predetermined explanatory variables as gmmstyle instruments. While both F-statistics and p-values are reported for Fisher test, only the p-values are reported for the three misspecification tests: autocorrelation tests (AR (1) & AR (2)); Over-Identifying Restrictions Tests (Sargan and Hansen); Adjusted and within R^2 are reported for OLS and FE models respectively.*

As shown in

Table 10, the lagged financial inclusion has a positive impact at the 1% level of significance. The coefficient lies between zero and one, indicating a partial catch-up effect. Moreover, the magnitude of the coefficient also indicates that the level of financial inclusion is improving from its past stage due to continuous efforts taken by each individual country in the COMESA region, which is in line with previous studies (Evans & Adeoye, 2016; Gebrehiwot & Makina, 2019; Eshun & Kočenda, 2025).

The above result shows a positive and strongly significant impact of financial stability on financial inclusion in COMESA, with all other variables remaining constant. Regarding scale, a 1 per cent increase in financial stability leads to a 0.159 per cent increase in financial inclusion, ceteris paribus. This suggests that a stable financial system encourages trust and confidence of households and business firms in the financial system and encourages them to use the formal financial system rather than the informal system. This result is in line with the theory of financial intimidation and financial deepening, as well as empirical evidence (Fungáčová & Weill, 2015; Mehrotra & Yetman, 2015; Sahay, 2015; Jima & Makoni, 2023). On the other hand, this finding contradicts the empirical evidence, which suggests that financial stability has a negative impact on financial inclusion. Financial stability adversely affects financial inclusion through conservative financial systems. Those scholars argue that an overly focused approach to financial stability leads the financial sector to adopt strict financial regulations (Khan, 2011; Dinh, 2025). This can limit the expansion of financial inclusion, resulting in the exclusion of vulnerable groups within society. Thus, even though a stable financial system facilitates the expansion of financial inclusion by ensuring trust and minimizing systemic risk, it can also hinder financial inclusion when the financial regulation is more conservative and focused on profitability.

Moreover, the economic growth measured by GDP per capita has a significant and positive impact on financial inclusion. The positive coefficient of 0.044 corresponds with a P-value which is less than 0.05. This suggests that the economic expansion led to increased financial inclusion. This finding is aligned with endogenous growth theory and demand-following theory. According to the endogenous growth theory (Romer, 1986; Lucas, 1988), economic growth stimulates demand for formal financial services by increasing income, improving human capital and fostering increased innovation.

Financial inclusion is enhanced as a result of economic growth, which provides people and businesses with access to a wider range of financial products. Additionally, this finding is consistent with the demand following theory. According to the demand-following theory, economic growth enhances demand towards financial services (Robinson, 1952). The economic expansion motivates the financial sector to diversify its financial products and services to meet the needs of households and firms. Besides, our finding is consistent with previous empirical studies (Cámara & Tuesta, 2014; Fungáčová & Weill, 2015; Gebrehiwot & Makina, 2019; Raichoudhury, 2020; Jima & Makoni, 2023; Eshun & Kočenda, 2025). Similarly, another study argued that households' opportunity to use financial services (to save, invest, buy insurance and transfer money) is increased when their per capita income rises (Le et al., 2019; Karakara et al., 2025). Our empirical analysis considers the effect of additional control variables while examining the impact of financial stability and economic growth on financial inclusion. Accordingly, domestic credit to the private sector and real interest rate have a positive and significant impact on financial inclusion. This indicates that improving the provision of credit to households and small businesses and favorable financial incentives play a crucial role in enhancing financial inclusion. On the contrary, mobile subscriptions, institutional quality, and Income inequality have a negative impact on financial inclusion at the 5% significance level, suggesting that without strong and efficient institutions and a more equitable income distribution, advances in financial technology alone are inadequate. In the meantime, government expenditure, the inflation rate, and the rural population growth rate have no significant impact on financial inclusion, suggesting that these macroeconomic and demographic variables did not influence financial inclusion in the region during the study period.

CONCLUSION AND RECOMMENDATIONS

The present study examined the impact of financial stability and economic growth on financial inclusion in the COMESA region. To achieve this objective, usable secondary data from 2007 to 2022 was collected and used from 17 COMESA member countries. To account for the multidimensionality of both financial inclusion and financial stability, a composite index was developed and used to measure them. A panel unit root test was conducted to assess the dataset's stationarity. Generally, the two-step system GMM was employed as an econometric estimation technique. Our econometric estimation results show that the lagged level of financial inclusion has a positive and significant effect on the current level of inclusion.

Based on the findings, it is possible to conclude that both financial stability and economic growth create favorable conditions to enhance financial inclusion in the region. more separately, financial stability affects financial inclusion positively, this means, financial stability in the study area plays favorable condition to increase financial inclusion, through reduction in transaction cost, information asymmetry and improving efficient resource allocation. Thus, it is possible to conclude that creating a stable financial system in the COMESA region enhances the confidence of households and small-scale businesses in the financial sector, encouraging broader participation in the formal financial system. The financial sector also expands its outreach. Similarly, the impact of economic growth on financial inclusion is positive and significant, suggesting that strong economic performance raises income levels, fortifies financial capacity, and encourages increased involvement in the financial system, all of which have a positive and substantial impact on financial inclusion.

The policy implications of this study are that the findings underscore the need for intentional changes within the financial markets to enable financial inclusion. This would require policies and actions, such as the regulatory opening of the financial services sector to smaller players with a community footprint. In South Africa, for instance, this is achieved by licensing retail supermarkets which allow individuals to transact at till points, as part of their single shopping trip. By doing so, the risks of holding cash are reduced, transaction costs are contained, and individuals do not need to incur additional travel costs to access financial services. Furthermore, existing banks, both private and state, should be mandated to develop low-cost transactional and savings accounts and products for individuals and MSMEs. This will ensure that funds accumulate and can be intermediated as loans to support developing businesses, provide trade finance to exporters, and asset building. By being included in the financial system, everyone would have an opportunity to contribute to the greater national good of economic development and sustained growth. The facilitation of trade can be enhanced by implementing the provisions of the AfCFTA agreement, which will remove trade barriers among member states. Higher trade levels will attract more investors and increase inward foreign capital flows. By lowering the costs of mobile data, governments can support financial inclusion and increase e-commerce activities and the visibility of goods and services beyond their borders.

The limitations of this study are that it focused exclusively on the COMESA region, hence its findings cannot be generalised to other countries or regions. Also, applying a composite index for financial inclusion may oversimplify the multidimensional nature of individual financial inclusion variables. To overcome these limitations, we suggest that future studies undertake a comparative analysis of COMESA and other economic blocs to determine whether the outcomes of this paper and those of other regions are similar or divergent, and the extent and robustness of these differences. Additionally, future studies can apply both an index and regress the individual measures of financial inclusion and institutional quality to determine if perhaps there are outliers in the individual drivers that are responsible for driving or hindering financial inclusion.

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Appendix-A: DATA AND VARIABLES

Table 11. Data and variables

Variable code	Definition of variables	Source of Data	Previous studies	Expected outcome
Dependent variable				
I. Financial inclusion index, FII (Evaluated using two stage PCA)			Sarma, 2008; Oyedotun & Makoni, 2026	+
a. Demographic-penetration dimension				
NATMAD	Number of ATM per 100,000 adults	IMF_FAS		
NBBAD	Number of bank branches per 100,000 adults	IMF_FAS		
NBACC	Number of bank accounts per 1000 adults	WDI_GFD		
b. Geographic-penetration dimension				
NBBA	Number of bank branches per 1000 km^2area	IMF_FAS		
NATMA	Number of ATMs per 1000 km^2 area	IMF_FAS		
c. Usage-dimension				
OUL	Outstanding loans as percentage of GDP	IMF_FAS		
OUD	Outstanding deposits as percentage of GDP	IMF_FAS		
Explanatory variables				
II. Financial stability Index, FSI (Evaluated using PCA)			Han & Melecky, 2013; Morgan & Pontines, 2018; Čihák et al., 2020; Damane & Ho, 2024	+
BCBD	Bank credit to bank deposits (%)	IMF		+
Z-score	Bank Z-scores	WDI_GFD		+
LATDS	Liquid assets to deposits and short-term funding (%))	IMF		+
III. Economic Growth, EG				
LnGDPPC	GDP per capita (constant 2015 US$)	WDI	Gebrehiwot & Makina, 2019; Mose & Thomi, 2021; Nsiah & Tweneboah, 2023; Adedokun & Ağa, 2021	+
IV. Control variables				
INFR	Inflation rate, Consumer price index (annual %)	IMF	Evans & Adeoye, 2016; Gebrehiwot & Makina, 2019; Le et al., 2019; Jima & Makoni, 2023, Mose & Thomi,	-

			2021; Nsiah & Tweneboah, 2023	
GEXP	Government expenditure, total (% of GDP)	WDI	Jima & Makoni, 2023; Nsiah & Tweneboah, 2023; Eshun & Kočenda, 2025	+
RUPOP_gr	Rural population growth (% of total population)	WDI	Gebrehiwot & Makina, 2019; Wokabi & Fatoki, 2019; Asuming et al., 2018; Tou & Diarra, 2025	-
MSUB	Mobile cellular subscriptions (per 100 people)	WB	Uddin et al., 2017; Gebrehiwot & Makina, 2019; Asuming et al., 2018, Jima & Makoni, 2023; Tou & Diarra, 2025	+
DCTP	Domestic Credit to the private sector as a % of GDP	IMF	Nsiah & Tweneboah, 2023; Huni et al., 2025	+
GINI	Income inequality	WB	Omar & Inaba, 2020; Park & Mercado, 2015	
RIR	Real interest rate	WB	Wokabi & Fatoki, 2019	
V. Institutional Quality Index, IQIN (Evaluated using PCA)			Nsiah & Tweneboah, 2023; Jima & Makoni, 2023; Huni et al., 2025	+
CCONTROL	Control of Corruption: Percentile Rank	WGI		
GGOVERNM	Government Effectiveness: Percentile Rank	WGI		
PPOLITIC	Political Stability and Absence of Violence/Terrorism: Percentile Rank	WGI		
RREGULAT	Regulatory Quality: Percentile Rank	WGI		
RRULEOFL	Rule of Law: Percentile Rank	WGI		
VVOICEAN	Voice and Accountability: Percentile Rank	WGI		

APPENDIX B. Principal Component Analysis

Table 12. Principal eigenvalue

	Component	Eigenvalue	Difference	Proportion	Cumulative
FI_Geo	Comp1	1.95477	1.90953	0.9774	0.9774
	Comp2	0.0452341		0.0226	1.0000
FI_Demo	Comp1	2.46898	2.07157	0.8230	0.8230
	Comp2	.397409	.263797	0.1325	0.9555
	Comp1	.133612		0.0445	1.0000

FI_Usage	Comp1	1.78021	1.56042	0.8901	0.8901
	Comp2	.219788		0.1099	1.0000

Table 13. Principal components (eigenvectors)

a. FI_geo

Variable	Comp1	Comp2
SNATMA	0.7071	0.7071
SNBBA	0.7071	-0.7071

b. FI_demo

Variable	Comp1	Comp2	Comp3
SNATMAD	0.6049	-0.2116	-0.7677
SNBBAD	0.5812	-0.5416	0.6073
SNBACC	0.5443	0.8136	0.2047

c. FI_usa

Variable	Comp1	Comp2
SOUD	0.7071	0.7071
SOUL	0.7071	-0.7071

Table 14. Second stage PCA: first stage PCA estimation results -financial inclusion index

a. Principal eigenvalues			
Component	Eigenvalue	Proportion (%)	Cumulative (100%)
Comp1	2.06389	68.8	68.8
Comp2	0.582197	19.41	88.2
Comp3	0.35391	11.8	100
b. Principal eigenvectors			
Variable	Comp1	Comp2	Comp3
SFI_geo	0.6114	-0.1726	-0.7722
SFI_demo	0.5785	-0.5683	0.5851
SFI_usa	0.5398	0.8045	0.2476

Table 15. Principal component analysis result -financial stability index

a. Principal eigenvalue

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.68509	0.65418	0.5617	0.5617
Comp2	1.03091	0.746915	0.3436	0.9053
Comp3	0.28399	.	0.0947	1

b. Principal components (eigenvectors)

Variable	Comp1	Comp2	Comp3	Unexplained
Z-score	0.1859	0.9454	-0.2677	0
BCBD	0.7136	0.0574	0.6982	0
LATDS	-0.6754	0.3208	0.664	0

Note that: *Z-score, BCBD* and *LATDS* represent *bank Z-scores*; *bank credit to bank deposits (%)*; and *liquid assets to deposits and short-term funding (%),* respectively.

Table 16. Principal component analysis result -institutional quality index

Component	Eigenvalue	% Variance	Cumulative %
Comp1	4.6954	78.26	78.26
Comp2	0.533142	8.89	87.14
Comp3	0.429	7.15	94.29
Comp4	0.187984	3.13	97.43
Comp5	0.0854077	1.42	98.85
Comp6	0.0690683	1.15	1

Table 17. Principal components (eigenvectors) for the institutional quality index

Variable	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6
CCONTROL (CC)	0.4114	-0.4693	0.0706	0.5885	0.3981	0.3173
GGOVERNM (GE)	0.4363	-0.1762	-0.3131	0.0584	-0.0341	-0.8222
PPOLITIC (PSA)	0.3734	-0.0124	0.8807	-0.2321	-0.0965	-0.1471
RREGULAT (RQ)	0.4265	-0.0176	-0.2765	-0.7048	0.4157	0.2681
RRULEOFL (RL)	0.442	-0.0489	-0.2097	0.0199	-0.793	0.3592
VVOICEAN (VA)	0.3517	0.8636	-0.0304	0.3151	0.1716	0.0284

MINIMIZE TAX AVOIDANCE: PROFITABILITY, LEVERAGE, AND MODERATING IMPACT OF THE AUDIT COMMITTEE

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ABSTRACT

Taxes are crucial for the country's growth, comprising a significant portion of the state budget. To ensure a fair tax burden and maintain the integrity of the tax system, the Indonesian government must address the issue of tax avoidance. This research paper aims to investigate the relationship between firm profitability, financial leverage, and the moderating impact of the audit committee on tax avoidance practices. This study examines the influence of leverage and profitability on tax avoidance practices within the Indonesian banking industry, focusing on firms listed on the Indonesia Stock Exchange from 2020 to 2022. The researchers also explored the moderating role of the Audit Committee. The sample was selected using purposive sampling, aligning with a quantitative research approach. Data from 27 companies were analyzed using Partial Least Square methods. The findings indicate that profitability does not significantly impact tax avoidance, while leverage exhibits a notable negative relationship with tax avoidance. Furthermore, the study reveals that the audit committee's oversight does not affect the relationship between profitability and tax avoidance. However, when leverage is under the audit committee's control, it substantially reduces instances of tax avoidance. Implications of this study suggest that firms with higher leverage tend to engage in less tax avoidance, likely due to the audit committee's monitoring and oversight role. The audit committee's ability to scrutinize and constrain the use of leverage for tax minimization purposes appears to be an effective deterrent against aggressive tax avoidance practices.

Keywords: audit committee; leverage; profitability; tax avoidance

INTRODUCTION

Taxes are a vital component of the state budget and are necessary to sustain the growth of the country. In the context of developing countries, including Indonesia, the practice of tax avoidance can hinder the government's ability to collect necessary revenues for public services and economic development (Johannesen et al., 2020). Despite the urgent need for revenue, many developing nations, including Indonesia, face challenges in enforcing tax compliance due to various tactics employed by businesses to lower their tax burdens (Payne & Raiborn, 2018). Tax avoidance, however, is still a major issue since both local and foreign businesses use a variety of tactics to reduce their tax liabilities. Tax avoidance is broadly defined as actions taken by company management to reduce corporate tax payments below what they should be (Handoyo et al., 2022). Tax avoidance not only impacts the financial aspects of businesses but also has ethical implications. It can decrease the perceived fairness of the tax system and affect the allocation of resources to government entities, leading to concerns about justice and fairness among taxpayers (Bird & Davis-Nozemack, 2018).

Indonesia has experienced a significant increase in tax revenue over the past two years, surpassing the targets set in Presidential Regulation No. 98 of 2022. Minister of Finance Sri Mulyani Indrawati announced a notable 34.3% growth in tax revenue, amounting to Rp1,717.8 trillion, exceeding the projected

growth by 115.6% (Tjondro & Olivia, 2018). The rise in tax revenue in Indonesia could be influenced by various factors associated with tax avoidance practices within the country. Research has indicated that tax avoidance is a prevalent issue among Indonesian companies due to the perceived high tax rates for business entities (Handoyo et al., 2022). Additionally, the impact of sustainability reporting on shareholder perceptions of tax avoidance has been emphasized, underscoring the ethical concerns linked to tax avoidance and its effects on government tax revenue (Rudyanto & Pirzada, 2020).

Corporate tax avoidance is a complex issue where many corporations utilize legal loopholes and intricate strategies to minimize their tax obligations, reducing their taxable base and impacting government revenue (Beer et al., 2020; Oats & Tuck, 2019). Companies engage in tax avoidance by strategically managing their tax payments to be lower than expected (Handoyo et al., 2022). Tax avoidance practices not only present financial challenges for tax authorities but also undermine critical societal structures necessary for regulatory compliance, organizational integrity, and overall well-being (Bird & Davis-Nozemack, 2018). This issue is exemplified by the case of PT Bank Central Asia Tbk, one of Indonesia's largest banks, which reported a significantly lower effective tax rate compared to the statutory rate in 2020, suggesting the presence of tax minimization strategies (Mocanu et al., 2021). While legally permissible, such practices deprive the government of crucial revenue required to fund essential public services and infrastructure development.

The degree of tax avoidance is further influenced by factors such as a company's leverage, size, and risk profile (Sari & Ramli, 2023). Leverage is a key factor that can shape a company's incentives and capabilities regarding tax avoidance activities. The level of a firm's debt financing, or leverage, plays a pivotal role in influencing its motivations and capacity to engage in tax minimization strategies. Highly leveraged companies are often incentivized to reduce their tax obligations to preserve cash flow and ensure they can fulfil their debt commitments (Damayanti & Wulandari, 2021). Research indicates that leverage can have a significant impact on tax avoidance activities (Khan et al., 2017). Several studies have identified leverage as a significant factor influencing tax avoidance practices. Sari & Ramli (2023) found that leverage, along with company size and company risk, collectively influence tax avoidance, with leverage specifically showing a significant impact on tax avoidance activities. Similarly, Damayanti & Wulandari (2021) highlighted that leverage has a significant positive effect on tax avoidance. Riguen et al. (2020) indicated that firms with higher leverage and sales growth tend to be more tax aggressive, suggesting that greater debt levels provide more opportunities for tax avoidance.

Leverage may not always have a significant impact on tax avoidance activities, as indicated by (Ekaristi et al., 2022), which found that leverage does not have a significant influence on tax avoidance. This contrasts with the common belief that leverage plays a crucial role in tax avoidance strategies. Additionally, Bird & Davis-Nozemack (2018) highlight tax avoidance as a sustainability problem, emphasizing that it goes beyond financial implications and can erode critical common spaces necessary for regulatory compliance and societal integrity. This perspective underscores the multifaceted nature of tax avoidance and its broader impact on various aspects of society beyond financial considerations.

Profitability is a significant factor influencing a company's engagement in tax avoidance practices. Highly profitable firms are more likely to pursue tax minimization strategies as reducing tax payments can lead to substantial benefits for these companies (Ekaristi et al., 2022). The maximization of profits is indeed a primary driver of tax avoidance, as lowering tax expenses can significantly increase a firm's profitability (Gulzar et al., 2018). Tax avoidance can also result in higher profit margins and increase the likelihood of firms meeting or exceeding analyst expectations (Khan et al., 2017). Furthermore, tax avoidance activities often aim to reduce taxable profits compared to accounting profits, with the intention of minimizing tax expenses (Marfiana & Putra, 2021). Research indicates that firms with higher profitability are more inclined towards tax planning and avoidance strategies (Shubita, 2024). Profitability plays a crucial role in shaping tax avoidance behaviours, with larger firms showing a slight preference for tax planning. Additionally, tax

avoidance has been associated with creating shareholder value by minimizing cash outflows to taxing authorities. The level of tax avoidance is influenced by management's tolerance for uncertainty, tax expertise of directors, and corporate social responsibility practices (Khurana et al., 2018).

While tax avoidance strategies may enhance profitability and financial performance in the short term, they can also pose substantial risks and drawbacks. Reducing taxable income through aggressive tax minimization tactics, despite providing immediate financial benefits, can undermine long-term organizational sustainability and societal well-being. Research indicates that highly profitable firms are more likely to engage in tax planning and avoidance practices, but this approach can erode critical foundations necessary for regulatory compliance and organizational integrity. The pursuit of profit maximization through aggressive tax minimization can have adverse consequences that extend beyond financial considerations, impacting broader social and ethical responsibilities. Highly profitable companies often demonstrate a propensity for tax planning and avoidance strategies to maximize their profits, but this practice can have detrimental ramifications (Mocanu et al., 2021). However, this pursuit of profit maximization through aggressive tax minimization strategies can have negative consequences that extend beyond financial considerations, impacting broader social and ethical responsibilities (Bird & Davis-Nozemack, 2018). Tax avoidance not only poses a financial problem for tax authorities but also erodes critical common spaces necessary for regulatory compliance, organizational integrity, and society.

The relationship between tax avoidance and profitability is also reflected in studies suggesting that tax avoidance can positively impact the value of listed firms (Ha et al., 2021). Moreover, firms with higher sales growth, which often correlates with increased profitability, are found to have greater incentives for tax planning and, consequently, engaging in tax avoidance practices (Riguen et al., 2020). Tax avoidance has been extensively studied in relation to its impact on the profitability and value of listed firms. Research indicates that firms engage in tax avoidance primarily to maximize profits by reducing tax expenses, which are a significant cost for companies (Gulzar et al., 2018). This reduction in tax expenses can indeed lead to a substantial increase in profits, demonstrating a positive relationship between tax avoidance and profitability. Additionally, tax avoidance has been shown to positively influence the value of listed firms, as managers strategically optimize taxes to lower the tax burden and increase profit levels (Ha et al., 2021). Studies have revealed that tax avoidance strategies can be adjusted based on fluctuations in profitability, with companies modifying their transfer pricing strategies to shift income to less profitable affiliates, illustrating a dynamic link between tax avoidance and profitability (Kim et al., 2019).

Research has dmonstrate that the pursuit of aggrssive tax minimization strategies can boost short-term profitability for companies, as the reduction in tax expenses directly leads to increased net income and profit margins. However, the long-term ramifications of such tax avoidance practice have been a subject of concern, as they can potentially compromise the organization's sustainability and its broader societal responsibilities. The key challenge lies in maintaining an appropriate balance between maximizing profitability through tax planning strategies and upholding the ethical and regulatory obligations that extend beyond narrow financial considerations. Companies must carefully navigate this complex landscape, as aggressive tax avoidance practices can provide immediate financial benefits but may also carry substantial long-term risks and ramifications for organizational sustainability and broader societal well-being. On one hand, businesses have a responsibility to their shareholders to optimize financial performance and create shareholder value. Tax planning and minimization strategies can significantly enhance profitability in the short term by reducing tax expenses and increasing net income. However, this single-minded pursuit of profit maximization through aggressive tax avoidance can undermine the company's longer-term viability and have detrimental impacts on various stakeholders, including employees, customers, local communities, and society at large. Businesses must prioritize both shareholder value creation and their wider responsibilities to these diverse stakeholders, the community, and the overall health of the economic system. This demands a nuanced, multifaceted approach that carefully weighs the short-term gains of tax minimization against the need to preserve the common spaces necessary for regulatory compliance,

organizational integrity, and societal trust and cohesion. Companies must strive to strike the right balance, leveraging tax planning strategies responsibly while upholding their ethical and social obligations to ensure sustainable success and contribute positively to the broader economic and societal landscape.

The audit committee plays a vital role in moderating the relationship between tax avoidance and profitability. Research suggests that a well-functioning audit committee can effectively constrain managers' tendencies to engage in aggressive tax minimization practices, thereby mitigating the potential adverse impacts on long-term organizational sustainability and societal well-being. Studies indicate that a robust audit committee acts as a regulatory mechanism, curbing managerial inclinations towards aggressive tax avoidance strategies and helping to safeguard the long-term viability of the organization and its broader societal responsibilities. The presence of a robust audit committee, along with factors such as profitability, institutional ownership, good corporate governance, and company size, significantly influences the level of tax avoidance within companies (Widiatmoko & Mulya, 2021; Damayanti & Wulandari, 2021; Widyastuti et al., 2022). Profitability has been highlighted as a key factor that can moderate the relationship between various variables such as institutional ownership, responsibility, and sales growth, impacting tax avoidance practices (Oktaviyani & Munandar, 2017; Iwanty & Surjandari, 2022; Shubita, 2024). Moreover, the effectiveness of the audit committee in controlling tax avoidance is emphasized, with studies pointing out that the audit committee acts as a controller within a company, ensuring good corporate governance practices (Riguen et al., 2020). The composition of the audit committee, including factors like financial expertise and gender diversity, also influences its ability to moderate tax avoidance (García-Meca et al., 2021; Soekarno & Setiawati, 2022).

The scholarly research on the relationship between tax avoidance, profitability, and the moderating influence of the audit committee holds immense significance. This body of academic work provides valuable insights that can inform decision-making in the corporate realm, shape public policies, and contribute to the broader well-being of society. Through rigorous empirical investigations and theoretical analyses, scholars have illuminated the complex dynamics at play, underscoring the need for a nuanced approach that balances the pursuit of profitability with ethical and regulatory obligations. The research emphasizes the pivotal role of the audit committee in constraining excessive tax avoidance practices, thereby safeguarding the long-term sustainability of organizations and their contributions to the larger economic and social landscape. Continued academic inquiry in this domain is essential for guiding businesses, policymakers, and stakeholders towards more responsible and balanced tax planning strategies that create value while upholding broader societal responsibilities.

LITERATURE REVIEW HYPOTHESIS

Agency theory, as defined by Jensen & Meckling (1976), focuses on the relationship between principals (owners) and agents (managers) within a company. This theory explains that conflicts of interest may arise due to differing objectives and incentives between the owners and managers. The agency relationship involves the delegation of authority and decision-making from principals to agents (Handoyo et al., 2022). Managers, as agents, are entrusted with the responsibility of handling company activities on behalf of the owners (Astrina et al., 2022). There is a recognized information asymmetry between principals and agents, where managers possess a broader understanding of company operations and finances (Amalia & Firmansyah, 2022). Furthermore, agency theory plays a crucial role in understanding and addressing conflicts of interest and information asymmetry between shareholders and management. It helps in comprehending the principal-agent problem, where managers may engage in tax avoidance practices to serve their own interests, potentially leading to conflicts with shareholders (Barros & Sarmento, 2020). The theory also aids auditors in navigating these conflicts and resolving issues related to information asymmetry between principals and agents (Rizkiana & Suripto, 2022).

Agency theory explains conflicts between managers and owners over tax avoidance, influenced by profitability, leverage, and governance, emphasizing alignment of managerial incentives with shareholder interests. (Oats & Tuck, 2019). Tax avoidance is a strategic approach employed by companies or individuals to minimize tax payments within the boundaries of the law (Kovermann, 2018). It involves activities aimed at reducing, eliminating, or deferring tax liabilities (Drake et al., 2019). The concept of tax avoidance spans a spectrum, ranging from legal tax planning to aggressive tax evasion. It can be seen as any action that decreases a firm's explicit taxes (Christensen et al., 2015). Strategies associated with tax avoidance can lead to either permanent or temporary tax savings and vary in terms of their level of aggressiveness and uncertainty (Simone et al., 2020). Tax avoidance practices can involve reducing both financial statement and taxable income, or solely focusing on decreasing taxable income, which impacts the effective tax rate (Sánchez-Ballesta & Yagüe, 2021). Companies engage in tax avoidance by exploiting weaknesses in tax regulations without violating the law (Damayanti & Wulandari, 2021).

Managers often employ tax avoidance strategies to enhance short-term profitability, consequently increasing the firm's value and potentially their own bonuses and incentives (Lara et al., 2009). Shifting income to minimize tax temporarily can respond to regulatory changes and serve as a long-term strategy, but tax avoidance poses reputational and regulatory risks to shareholders. High profitability can exacerbate these conflicts, as it may provide managers with more resources to engage in activities like tax avoidance, which can impact the firm's financial performance and shareholder value (Iwanty & Surjandari, 2022). Profitability, as a moderating variable, can influence the extent to which tax avoidance practices are employed by managers (Chung et al., 2019). Additionally, factors such as leverage, institutional ownership, and business strategy can also play a role in shaping the dynamics of tax avoidance within firms (Hsu et al., 2018). The presence of an effective audit committee and strong corporate governance mechanisms can help mitigate agency conflicts related to tax avoidance (Tjondro & Olivia, 2018). Furthermore, the expertise of the board of directors and their ability to oversee managerial decisions, including those related to tax practices, can impact the level of tax avoidance within a company (Zhong & Li, 2016). The composition of the board, including factors like gender diversity, can also influence tax avoidance practices (Lanis et al., 2021).

Profitability indicators are essential metrics for assessing a company's financial performance and its capacity to generate revenue from operations. They not only demonstrate the profits earned in a specific period but also act as a gauge of management's effectiveness within an organization (Ha et al., 2021). Profitability can be influenced by various factors such as tax avoidance strategies (Handoyo et al., 2022). Tax avoidance significantly impacts a company's profitability by reducing the tax burden and increasing after-tax profits, thereby improving shareholder assets and corporate value.

Leverage, a crucial financial metric, reflects the extent to which a company utilizes debt in its operations. As a firm's leverage increases, it can impact various aspects of its financial management, including tax avoidance strategies. Studies have shown that leverage plays a significant role in influencing tax avoidance practices within companies (Widyastuti et al., 2022; Damayanti & Wulandari, 2021; Nailufaroh et al., 2022). Higher leverage levels can lead to increased tax avoidance, as firms may strategically manage their liabilities to minimize tax burdens (Widyastuti et al., 2022). Additionally, leverage is identified as a factor that can influence the conflict of interest between shareholders and executive management, highlighting the intricate relationship between financial structure and tax management (Sari & Ramli, 2023).

Thie effectiveness of thie audit committee, within corporate governance, significantly moderates profitability, leverage, and tax avoidance practices. It serves as a crucial component, particularly for public companies, ensuring good corporate governance and influencing business strategy and managerial decision-making. The Sarbanes-Oxley Act expands audit committee oversight responsibilities, impacting tax avoidance behaviors. Internal governance mechanisms, such as board independence, interact with market

competition to shape tax strategies. The structure of ownership, including the presence of female directors, affects tax avoidance behavior, underscoring diversity's importance in governance.

Profitability is a key factor influencing tax avoidance strategies adopted by businesses. As profitability increases, firms tend to have greater resources and incentives for tax planning activities to minimize tax liabilities (Shubita, 2024). Larger firms are more inclined towards tax planning, leveraging profitability for complex tax avoidance strategies. This can lead to decreased tax burdens, increasing profitability, and benefiting stakeholders, especially shareholders (Rudyanto & Pirzada, 2020). Studies indicate that highly profitable firms are more likely to have aggressive tax policies, suggesting a positive association between profitability and tax avoidance practices (Riguien et al., 2020). Increasing profitability enables companies to optimize tax liabilities by minimizing tax burdens, resulting in proactive engagement in tax avoidance practices (iEkaristi et al., 2022). Profitability positively affects tax avoidance, indicating that more profitable companies are more inclined to engage in avoidance activities (Widyastuti et al., 2022). Larger, stable profits encourage firms to practice tax avoidance due to substantial tax burdens, prompting efforts to reduce liabilities (Ilmiyono & Agustina, 2020). The relationship between profitability and tax avoidance highlights profitability's central role in shaping tax strategies. Evidence supports the notion that profitable companies manage tax obligations more proactively, thus engaging in tax avoidance activities to maximize financial performance. Thus, one possible possibility is:
H_1: Profitability has a positive effect on tax avoidance.

The leverage ratio, also known as the solvency ratio, is a crucial metric used to evaluate the extent to which a company finances its operations through debt (Oktaviyani & Munandar, 2017). A higher leverage ratio indicates that a firm relies more on borrowed funds, leading to increased interest expenses due to debt usage. This heightened interest burden can potentially result in a higher tax liability for the organization (Mocanu et al., 2021). Research suggests that larger companies with lower financial performance and lower leverage ratios tend to engage more in tax avoidance practices. Furthermore, studies have shown that profitability and leverage have a positive impact on tax avoidance, indicating that firms with higher profitability and leverage ratios are more inclined to engage in tax avoidance strategies (Widyastuti et al., 2022). Tax avoidance is a significant concern for companies, as high debt levels can introduce risks that may lead to potential bankruptcy and encourage tax avoidance practices (Sari & Ramli, 2023). The relationship between leverage, profitability, and tax avoidance is intricate, with leverage playing a role in influencing tax avoidance strategies adopted by firms (Widyastuti et al., 2022). Additionally, the level of leverage a company maintains can impact its tax avoidance practices, with higher leverage potentially leading to increased tax avoidance efforts. Leverage has been consistently shown to have a positive impact on tax avoidance in manufacturing companies listed on the Indonesia Stock Exchange. Afrianti et al. (2022) found that leverage positively influences tax avoidance in these companies. Similarly, Damayanti & Wulandari (2021) and Wahyuni et al. (2017) also support this claim, demonstrating a significant positive relationship between leverage and tax avoidance. Marfiana & Putra (2021) further affirm the positive effect of leverage on tax avoidance. All these results point to the importance of leverage in tax evasion schemes. Thus, one possible possibility is:

H2: Leverage has a positive effect on tax avoidance.

The audit committee plays a crucial role in influencing tax avoidance practices within organizations through the lens of agency theory. By acting as a monitoring mechanism, the audit committee evaluates the accounting and taxation policies implemented by management, indirectly impacting management decisions regarding tax obligations (Widiatmoko & Mulya, 2021). Organizations with competent audit committees are more likely to promote ethical and transparent tax practices, as these committees can oversee and assess the tax strategies employed by the firm (Widuri et al., 2019). However, discrepancies may arise when managerial decisions do not align with the internal monitoring conducted by the audit committee, potentially compromising the independence of the firm in financial decision-making processes. Studies

have shown that various factors such as profitability, corporate social responsibility, institutional ownership, and corporate governance significantly influence tax avoidance practices within companies (Iwanty & Surjandari, 2022; Widyastuti et al., 2022; Khurana et al., 2018; Suleiman, 2020). For instance, profitability has been identified as a key factor that can moderate the impact of other variables on tax avoidance, indicating that firms with higher profitability may engage in different tax avoidance strategies compared to less profitable firms (Iwanty & Surjandari, 2022; Widyastuti et al., 2022). Moreover, the presence of female representation in governance structures, including the audit committee, has been associated with a positive effect on tax avoidance practices (Suleiman, 2020). Furthermore, the literature suggests that the effectiveness of the audit committee in mitigating tax avoidance may vary based on factors such as company size, ownership structure (family vs. non-family firms), and the expertise of the board of directors (Tjondro & Olivia, 2018; Lanis et al., 2021). In conclusion, the audit committee's role in overseeing tax practices is essential for promoting transparency and ethical behaviour within organizations. By evaluating accounting and taxation policies, the audit committee can indirectly influence management decisions regarding tax avoidance. Factors such as profitability, corporate governance, and industry dynamics play significant roles in shaping tax avoidance practices within firms, highlighting the complex interplay of internal and external factors in tax decision-making processes. So, the hypothesis can be:

H3 The audit committee can weaken the effect of profitability on tax avoidance.

The audit committee plays a crucial role in overseeing tax-related decisions within organizations, particularly in high leverage scenarios. Audit committees act as internal oversight mechanisms that supervise a firm's financial policies and practices, identifying risks associated with debt policies and ensuring compliance with tax regulations to reduce the likelihood of unauthorized tax avoidance practices. Research by Tjondro & Olivia (2018) highlights the audit committee's role as a moderator in balancing tax avoidance and the cost of debt, emphasizing the significance of effective oversight by the audit committee in managing these factors. Additionally, Widyastuti et al. (2022) found that variables like profitability and leverage have a positive impact on tax avoidance, further underlining the importance of the audit committee in regulating tax-related activities. Moreover, Handoyo et al. (2022) indicate that managerial ownership and the presence of an audit committee positively influence tax avoidance practices, suggesting that a robust audit committee can enhance tax compliance and reduce the likelihood of tax avoidance within companies. These findings underscore the critical role of the audit committee in monitoring and regulating tax-related activities to ensure adherence to legal requirements and minimize the risk of tax avoidance practices. So, the hypothesis can be:

H4: The audit committee can weaken the effect of leverage on tax avoidance.

The framwork is presented in Figur 1 as follows:

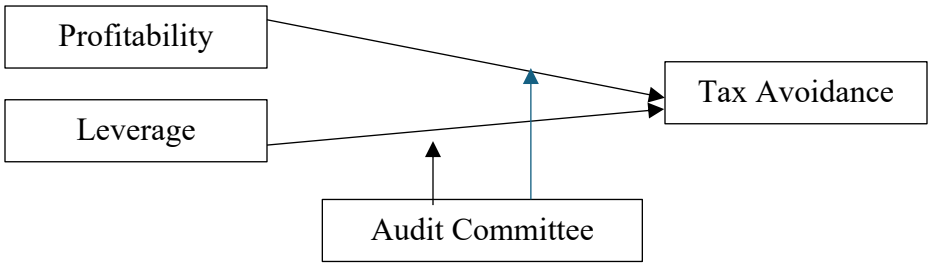

Figure 1. Conceptual Framwork (*Source: Data processed, 2024)*

METHODOLOGY

This study adopts an explanatory and quantitative research approach. It primarily involves conducting calculations, classifications, and theory testing using numerical research variables, as well as performing data comparisons and analyses. The secondary data utilized in this research is sourced from banking sector firms listed on the Indonesia Stock Exchange, which can be accessed through the official website of the Indonesia Stock Exchange (www.idx.co.id). The study's sample comprises 47 banking companies that were listed between 2020 and 2022 on the Indonesia Stock Exchange.

The focus on banking companies is due to their typically high levels of leverage compared to firms in other industries. This makes them a compelling subject to investigate how leverage, a key financial characteristic of banks, influences their tax policies and tax avoidance practices. Banks often rely heavily on debt financing, which can create incentives to engage in tax minimization strategies to offset the costs associated with high leverage. Banks, due to their high leverage levels, are an intriguing subject for exploring the relationship between leverage, tax policies, and tax avoidance practices. The reliance on debt financing in banks can create incentives for engaging in tax minimization strategies to offset the costs associated with high leverage (Langenmayr & Reiter, 2022). Audit committees in banks play a crucial role in overseeing tax-related decisions and potentially mitigating aggressive tax avoidance activities within these highly leveraged institutions (Hsu et al., 2018). The study by highlights that bank utilize profit shifting channels different from those of other firms, emphasizing the unique tax avoidance strategies employed by banks. The sample selection follows a purposive sampling technique, where the criteria for inclusion are as follows:

1. Banking companies listed on the Indonesia Stock Exchange within the 2020-2022 research period.
2. Banking companies that provided detailed annual financial reports during the study period.
3. Banking companies that did not incur losses from 2020 to 2022.

The dependent variable in this study is tax avoidance. Tax avoidance is a strategic approach adopted by companies to minimize tax liabilities within the boundaries of the law. Effective Tax Rate (ETR) serves as a key metric to gauge tax avoidance, where a higher ETR signifies lower tax avoidance and vice versa (Kim et al., 2019). Moreover, the ETR is utilized as a proxy for tax avoidance in empirical analyses, where lower ETRs indicate increased involvement in corporate tax avoidance (Gulzar et al., 2018). However, challenges arise when using ETR as a proxy for tax avoidance, particularly when pre-tax income is negative, leading to potential measurement issues (Kovermann, 2018). Despite these limitations, ETR-based measures remain prevalent in tax avoidance research due to their capacity to offer insights into future tax cash flows and risks linked to tax planning activities (Drake et al., 2019). The formula for calculating ETR is as follows:

$$\text{Effective Tax Rate (ETR)} = \frac{\text{Income Tax Expense}}{\text{Profit Before Taxes}}$$

The independent variables in this study are: profitability and leverage. Profitability in a company, often measured by the Return on Assets (ROA) ratio, reflects the firm's ability to generate profits from its assets. Studies have shown that profitability, as indicated by ROA, can influence tax avoidance behaviors in companies. The profitability measure Return on Assets (ROA) is often controlled for in tax avoidance studies because profitable firms have greater incentives to engage in tax aggressive behaviors (Riguen et al., 2020). The following formula can be used to determine ROA :

$$\text{Return on Assets (ROA)} = \frac{\text{Net Profit}}{\text{Total Assets}}$$

Leverage, a critical metric in evaluating a firm's financial structure, is commonly assessed using the Debt-to-Assets Ratio (DAR) (Zhang et al., 2022). Leverage is defined as the ratio measuring the extent to which a firm's assets are financed by long-term debt. The formula for calculating DER is as follows:

$$\text{Debt-to-Assets Ratio (DAR)} = \frac{\text{Total Liabilities}}{\text{Total Assets}}$$

The moderating variables is audit committee. Audit committee is measured by the number of audit committee members, as prior studies have shown that the size of the audit committee can affect its effectiveness in monitoring tax-related activities and mitigating tax avoidance practices. The effectiveness of an audit committee in monitoring tax-related activities and mitigating tax avoidance practices is influenced by various factors. Research indicates that financial expert audit committee members can impact the oversight of corporate tax planning processes (Hsu et al., 2018).

$$KA = \sum \text{Member of Audit Committee}$$

This study employs Partial Least Squares analysis, which is a structural equation technique that focuses on both latent variables and manifest variables within the Structural Equation Model (SEM) framework. PLS is a fundamental component of Structural Equation Model, a multivariate statistical analysis methodology.

RESULT AND DISCUSSION

This study examined banking firms listed on the Indonesia Stock Exchange from 2020 to 2022, utilizing data available on the official exchange website at www.idx.co.id. The key variables investigated include leverage, profitability, tax avoidance, and the audit committee. A purposive sampling approach was employed to select the research sample, which comprised 26 firms registered on the Indonesia Stock Exchange during the 2020-2022 period. Over this three-year timeframe, a total of 78 observations were collected. The data analysis methodology utilized in this research was Partial Least Square Analysis, a structural equation modelling technique that evaluates both latent and manifest variables. Table 1 describes the sample drawing process in this study.

Table 1. Research Sample Withdrawal Results

No.	Sample Selection Criteria	Total
Number of banking companies in 2022		47
1.	Banking companies that have not been listed on the Indonesia Stock Exchange (IDX) in the 2020-2022 research year	4
2.	Banking companies that do not have financial statements and inform the annual monetary statement in detail during the study period	1
3.	Banking companies that experienced losses in the period 2020-2022	17
Total Observation year 2020-2022 Number of Samples to be Observed in Research		26 3 78

Source: Data processed, 2024

Table 2 presents the findings of the descriptive statistical analysis for the variables of tax avoidance, audit committee, leverage, and profitability. The following is a summary of the descriptive statistics for each variable:

Table 2. Descriptive Statistical Test Results

Variable	Minimum	Maximum	Mean	Std. Deviation
Profitability	0.000	0.178	0.015	0.024
Leverage	0.137	8.598	0.876	0.903
Audit committee	3.000	8.000	4.170	1.333
Tax avoidance	0.012	0.659	0.246	0.097

Source: Data processed, 2024

The profitability variable exhibits a minimum value of 0.000 and a maximum of 0.178, with a mean of 0.01465 and a standard deviation of 0.023708. This statistic indicates that the standard deviation of profitability exceeds its mean, suggesting substantial variation in the profitability data. The leverage data exhibits a broad range, with a minimum value of 0.137 and a maximum of 8.598, and a mean of 0.87601 alongside a standardized deviation of 0.903244. This indicates substantial variation in the leverage data. The audit committee data, on the other hand, shows a more controlled variation, with a minimum value of 3 and a maximum of 8, a mean of 4.17, and a standardized deviation of 1.333, which is smaller than the mean. Regarding tax avoidance, the data displays a minimum value of 0.012 and a maximum of 0.659, with a mean of 0.24647 and a standard deviation of 0.097026. This suggests a relatively low level of variation in the tax avoidance data.

Before testing the hypothesis, outer model testing is first carried out. Furthermore, Goodness of Fit (GoF) testing obtained a value of 0.8746, which is included in the large group, so it can be concluded that the following research model is considered good.

Figure 2 shows the results of the analysis of the Research Model with the PLS (Partial Least Square) Method:

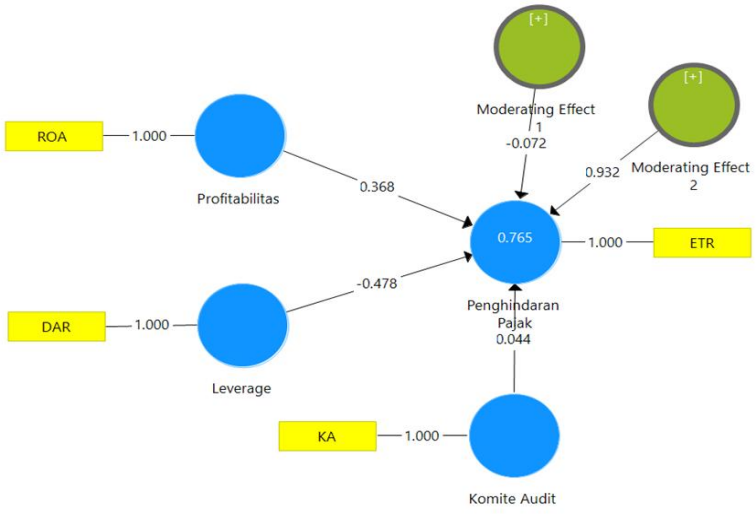

Figure 2. Research Structural Equation Model (*Source: Data processed, 2024)*

The results of hypothesis testing are presented in Table 3 as follows:

Table 3. Hypothesis Testing Results

Description	Correlation Coefficient	t statistic	p values	
Profitability -> Tax avoidance	0.368	0.996	0.322	No Significant
Leverage -> Tax avoidance	-0.478	2.302	0.024	Significant
Profitability* Audit committee -> Tax avoidance	-0.072	0.175	0.862	No Significant
Leverage * Audit committee -> Tax avoidance	0.932	6.233	0.000	Significant

The results of testing the first hypothesis indicate that the correlation coefficient between profitability and tax avoidance is 0.368, with a p-value of 0.322, which is greater than the conventional significance level of 0.05. This suggests that the positive relationship between profitability and tax avoidance observed in the data is not statistically significant. Therefore, the first hypothesis that profitability has a significant influence on tax avoidance practices must be rejected.

These findings indicate that the level of profitability alone does not appear to be a key driver of tax avoidance behaviour among the banking companies in the sample. Other factors, such as corporate governance mechanisms, industry dynamics, or strategic considerations, may play a more prominent role in shaping the tax avoidance practices of these firms. The results imply that simply being more profitable does not necessarily lead banking companies to engage in more aggressive tax planning or avoidance activities. Instead, the decision to minimize tax obligations may involve a more complex interplay of organizational, financial, and regulatory factors that extend beyond just profitability levels.

The findings of this study do not fully support the predictions of agency theory. While the observed inverse relationship between leverage and tax avoidance suggests that higher debt levels may serve as a mechanism to align the interests of managers and shareholders, the lack of a significant relationship between profitability and tax avoidance indicates that the agency theory framework may not adequately capture the complex factors influencing tax avoidance behaviour in the banking sector. The results imply that other corporate governance mechanisms, industry dynamics, and strategic considerations beyond just profitability and leverage may play a more prominent role in shaping tax minimization practices among these firms. The assertion that profitability significantly influences tax avoidance practices must be reconsidered based on the synthesized evidence from reputable sources. While it is commonly believed that higher profitability may lead to reduced tax avoidance, the research findings suggest a more nuanced relationship. Studies by Zhang et al. (2022), Mocanu et al. (2021), and Barros & Sarmento (2020) indicate that tax avoidance is influenced by various factors beyond profitability. Zhang et al. (2022) highlight that tax profitability plays a role in tax avoidance, but it is not the sole determinant. Mocanu et al. (2021) suggest that higher profitability may make companies less inclined towards tax avoidance, indicating a negative relationship.

Additionally, Barros & Sarmento (2020) found that more profitable firms are not necessarily engaged in more tax avoidance, further challenging the direct link between profitability and tax avoidance. Moreover, research by Widiatmoko & Mulya (2021) and Amidu et al. (2019) emphasizes that profitability, along with other factors like good corporate governance and company size, influences tax avoidance practices. These studies suggest that profitability is just one of several factors that contribute to tax avoidance behaviour. In conclusion, while profitability may have some influence on tax avoidance

practices, the evidence suggests that it is not the sole or primary factor determining the extent of tax avoidance. Other variables such as corporate governance, audit committee characteristics, and firm size also play significant roles in shaping tax avoidance behaviour. The findings indicate that the relationship between profitability and tax avoidance is often non-linear, affected by institutional factors. In developing markets, profitable companies face heightened regulatory scrutiny, deterring aggressive tax planning to protect their reputation. The study's trivial profitability effect suggests that tax authorities and regulators should broaden oversight beyond just high-profit firms, focusing on enhancing governance frameworks like board independence and audit transparency. Bank management should incorporate tax ethics into CSR strategies, prioritizing long-term sustainability through public trust and regulatory compliance over short-term tax savings.

The results of the second hypothesis test indicate a statistically significant negative correlation between leverage and tax avoidance. Specifically, the correlation coefficient between these two variables is -0.478, with a p-value of 0.024, which is less than the conventional significance level of 0.05. This finding suggests that higher levels of financial leverage, as measured by the debt-to-equity ratio, among the banking companies in the sample are associated with lower levels of tax avoidance behaviour. In other words, an increase in the use of debt financing appears to contribute to a decrease in the extent to which these firms engage in tax minimization strategies and practices. This inverse relationship between leverage and tax avoidance could be attributable to several factors, such as the increased scrutiny and monitoring that comes with higher debt levels, the desire to maintain a positive credit profile and access to capital markets, or the reduced financial incentives to aggressively pursue tax minimization when a significant portion of earnings is already committed to debt servicing. The implication is that the capital structure decisions of these banking firms play a meaningful role in shaping their tax planning and compliance strategies.

The findings of this study support the predictions of agency theory, which posits that the separation of ownership and control in corporations can lead to conflicts of interest between managers and shareholders. Specifically, the observed inverse relationship between leverage and tax avoidance suggests that higher debt levels, and the associated increased monitoring and scrutiny from creditors, may serve as a mechanism to align the interests of managers and shareholders. When financial leverage is higher, managers may be less inclined to pursue aggressive tax avoidance strategies that could jeopardize the firm's creditworthiness and access to capital markets. This implies that the capital structure decisions of these banking firms play a meaningful role in shaping their tax planning and compliance strategies, aligning with the predictions of agency theory. There is a relationship between financial leverage, tax avoidance behaviour, and the debt-to-equity ratio among banking companies. Mocanu et al. (2021) found that larger companies with lower financial performance and lower leverage ratios are more inclined towards tax avoidance. Amidu et al. (2019) also support this by suggesting that higher levels of leverage are positively correlated with tax avoidance, indicating that highly leveraged financial firms tend to engage more in tax avoidance practices.

Langenmayr & Reiter (2022) found that the leverage ratios of the largest banks respond less to tax incentives compared to smaller banks. This suggests that the size of the bank may influence how leverage ratios are affected by tax incentives, impacting tax avoidance behaviour. Additionally, Kovermann (2018) concluded that banks charge lower loan spreads and impose fewer covenant restrictions when firms exhibit more tax avoidance, indicating a potential relationship between tax avoidance and the cost of debt in a bank-dominated economy. In summary, the synthesis of these references suggests that higher levels of financial leverage, as indicated by the debt-to-equity ratio, among banking companies are associated with lower levels of tax avoidance behaviour. Larger companies with lower financial performance and lower leverage ratios tend to engage more in tax avoidance practices, while the response of leverage ratios to tax incentives varies between large and small banks. Furthermore, the cost of debt in a bank-dominated economy may be influenced by firms' tax avoidance behaviour. The negative correlation between debt ratios and tax avoidance underscores debt's role as a monitoring mechanism. As international studies

indicate, creditor pressure and interest obligations restrict managers' aggressive tax planning due to liquidity risks and oversight. Recommendations for regulators include enhancing macroprudential policies alongside tax oversight, using debt risk profiles to gauge tax compliance. From a corporate governance perspective, boards should view high capital structures as promoting operational transparency rather than merely financial burdens. Strengthening risk monitoring committees to assess the balance between debt obligations and tax efficiency is vital for companies to uphold credibility while adhering to fiscal regulations.

The third hypothesis test results indicate that the p-value of 0.862 is greater than the conventional significance level of 0.05, leading to the rejection of H3. This finding suggests that the audit committee is unable to effectively moderate the relationship between profitability and tax avoidance. The presence of an audit committee does not seem to significantly influence or constrain the link between a firm's profitability and its level of tax avoidance behaviour. This implies that the audit committee, despite its oversight responsibilities, does not appear to play a significant role in mitigating the tendency for more profitable firms to engage in greater tax minimization strategies. The lack of a moderating impact by the audit committee suggests that other corporate governance mechanisms or external factors may be needed to help curb the propensity for highly profitable firms to pursue aggressive tax avoidance practices. Overall, this result challenges the notion that the audit committee can serve as an effective check on the relationship between a company's financial performance and its tax planning decisions.

The findings do not support agency theory, which proposes that the separation of ownership and control in corporations can lead to conflicts of interest between managers and shareholders. According to agency theory, higher debt levels and the associated increased monitoring and scrutiny from creditors may serve as a mechanism to align the interests of managers and shareholders. However, the lack of a moderating impact by the audit committee on the relationship between profitability and tax avoidance suggests that the governance mechanisms in place may not be effectively addressing these potential agency conflicts. This implies that further research is needed to understand the role of other corporate governance mechanisms in shaping tax avoidance behaviour, particularly in the context of highly profitable firms.

The association between a firm's profitability and its level of tax avoidance is a multifaceted dynamic influenced by diverse factors, including the presence of an audit committee. While the audit committee is expected to serve a monitoring role in mitigating aggressive tax avoidance strategies, the extant literature suggests mixed evidence regarding its effectiveness in constraining such practices. Relevant research by Handoyo et al. (2022) and Tjondro & Olivia (2018) indicates that the audit committee may not consistently succeed in deterring tax avoidance and could even inadvertently incentivize such behaviour. Furthermore, the audit committee's role in moderating the trade-off between tax avoidance and the cost of debt may not always align with the objective of curtailing tax avoidance practices. Ultimately, the ability of the audit committee to effectively moderate the relationship between profitability and tax avoidance remains an area requiring further investigation, particularly considering the findings of this study that challenge the notion of the audit committee as a reliable check on the tax planning decisions of highly profitable firms. The audit committee's inability to influence the relationship between profitability and tax avoidance reflects the global "symbolic compliance" critique. Research indicates that audit committees often lack tax-specific expertise, focusing instead on general financial reporting. This suggests that their existence may serve merely to meet regulatory requirements without significant input on management's fiscal strategies. Regulators are encouraged to establish tax competency standards for audit committee members, while companies should ensure these committees evolve from mere compliance monitors to strategic risk evaluators. This shift would help align the interests of shareholders and management by addressing the reputational risks of aggressive tax avoidance.

The results of the fourth hypothesis test confirm that the p-values are statistically significant, suggesting that H_4 is supported. This finding indicates that the audit committee can effectively moderate the relationship between financial leverage and tax avoidance behaviour among banking companies.

Specifically, the presence of an active and competent audit committee can influence the connection between a firm's capital structure, as measured by its debt-to-equity ratio, and its engagement in tax minimization strategies. This implies that the audit committee can potentially serve as an important governance mechanism to constrain excessive or aggressive tax avoidance practices, particularly in highly leveraged banking firms. The moderating impact of the audit committee highlights its role in monitoring and mitigating the tendency for leveraged banks to pursue overly aggressive tax planning that could jeopardize their creditworthiness and access to capital markets. This finding underscores the importance of a robust and effective audit committee in shaping the tax compliance and transparency practices of banking institutions.

The findings suggest that the audit committee's oversight can help align the interests of managers and shareholders in the context of tax planning decisions for highly leveraged banking companies. By constraining aggressive tax avoidance strategies, the audit committee can play a crucial role in ensuring that banks maintain financial stability and preserve their access to capital markets. This is particularly important in the banking sector, where excessive tax avoidance can have significant implications for the overall financial system. The effective monitoring and guidance provided by the audit committee can help foster a culture of tax compliance and responsible tax planning among banking institutions, contributing to the long-term sustainability and stability of the financial sector. Audit committee members with financial expertise are uniquely positioned to oversee and advise on the tax planning activities of firms, helping to mitigate related risks (Hsu et al., 2018). The structure of company ownership, whether family or non-family firms, influences the effectiveness of the audit committee in managing the trade-off between tax avoidance and the cost of debt (Tjondro & Olivia, 2018). Additionally, audit committee financial expertise, especially in the context of the Sarbanes-Oxley Act, expands oversight responsibilities, including preapproving non-audit services, which can impact tax services provided by auditors (Bédard & Paquette, 2021).

This finding supports agency theory, which suggests that the separation of ownership and control in corporations can lead to conflicts of interest between managers and shareholders. According to agency theory, higher debt levels and the associated increased monitoring and scrutiny from creditors may serve as a mechanism to align the interests of managers and shareholders. The results of this study indicate that the audit committee can effectively play a similar role in constraining the tendency for highly leveraged banking firms to engage in aggressive tax avoidance practices, thereby aligning the interests of managers and shareholders. This highlights the crucial role of the audit committee in corporate governance and its potential to mitigate agency conflicts in the context of tax planning decisions.

The relationship between financial leverage and tax avoidance behaviour among banking companies can be influenced by the presence and effectiveness of the audit committee (Soekarno & Setiawati, 2022; Ashrafi et al., 2022). Research by Shin & Park (2019) suggests that strong internal governance mechanisms, including board independence and audit committee independence, can enhance the impact of factors such as product market competition on tax avoidance behaviour. This implies that the audit committee, when independent and effective, can play a crucial role in moderating the relationship between financial leverage and tax avoidance practices in banking companies. Furthermore, the study by Tjondro & Olivia (2018) highlights that the structure of company ownership, such as family versus non-family firms, can determine the effectiveness of the audit committee in reducing the trade-off between tax avoidance and the cost of debt. This underscores the importance of considering the specific organizational context when assessing the role of the audit committee in influencing tax avoidance behaviour. In conclusion, the presence of an audit committee, particularly when coupled with independence and expertise, can potentially moderate the relationship between financial leverage and tax avoidance behaviour among banking companies. However, the effectiveness of the audit committee in this regard may vary based on factors such as internal governance mechanisms and company ownership structure, highlighting the need for further research to fully understand the dynamics at play. The findings regarding the crucial role of audit committees in mitigating agency conflicts and balancing capital structure with tax compliance

align with post-financial crisis trends in global banking supervision, where fiscal transparency is now considered an indicator of systemic stability. International studies, such as those conducted in the European banking ecosystem, indicate that audit committees with "tax literacy" not only fulfill the mandate of the Sarbanes-Oxley Act but also serve as reputational gatekeepers, preventing banks from becoming entangled in costly fiscal litigation. This implies that for banking firms, aggressive tax avoidance is often viewed as a signal of governance risk by global investors. Practically, regulators are advised to encourage standardization of audit committee charters that explicitly require periodic reviews of tax planning strategies as part of corporate risk management. Furthermore, banking firms should ensure that audit committees include members with a background in tax law or senior financial auditing to ensure that capital structure (debt) decisions remain aligned with tax ethics, thus maintaining capital market confidence and long-term access to funding.

CONCLUSION

The findings of this study highlight the important role of the audit committee in moderating the relationship between financial leverage and tax avoidance behaviour among banking companies. The audit committee's oversight and monitoring can help align the interests of managers and shareholders, constraining excessive or aggressive tax planning practices, particularly in highly leveraged banking firms. This is crucial in the banking sector, where excessive tax avoidance can have significant implications for financial stability and access to capital markets. The effective monitoring and guidance provided by the audit committee can foster a culture of tax compliance and responsible tax planning among banking institutions, contributing to the long-term sustainability and stability of the financial sector. Audit committee members with financial expertise are uniquely positioned to oversee and advise on the tax planning activities of firms, helping to mitigate related risks.

The findings of this study support agency theory, suggesting that the audit committee can play a similar role to increased debt levels in aligning the interests of managers and shareholders. This highlights the crucial role of the audit committee in corporate governance and its potential to mitigate agency conflicts in the context of tax planning decisions. Overall, the presence of an effective and independent audit committee can be a valuable governance mechanism in moderating the relationship between financial leverage and tax avoidance behaviour among banking companies. However, the effectiveness of the audit committee may vary based on factors such as internal governance mechanisms and company ownership structure, emphasizing the need for further research in this area.

Policy Recommendation for Governments: Policymakers should consider implementing regulations that strengthen the role and independence of audit committees within the banking sector. This could involve establishing requirements for financial expertise among committee members, as well as providing clear guidelines on their oversight responsibilities regarding tax planning and risk management. By enhancing the audit committee's ability to effectively monitor and constrain aggressive tax avoidance practices, governments can help promote financial stability and responsible tax compliance within the banking industry. Based on these findings, there are several practical implications that can be implemented by various stakeholders. For regulators and tax authorities, it is important to not only focus on highly profitable companies but also expand oversight of low-profit companies by encouraging improved governance and transparency. Regulators are also advised to strengthen macroprudential policies by utilizing a company's debt risk profile as an indicator of tax compliance and establishing mandatory tax competency standards for audit committee members. Meanwhile, for company management, particularly in the banking sector, integrating tax ethics into Corporate Social Responsibility (CSR) strategies is crucial for shifting from a focus on short-term tax savings to long-term sustainability. Furthermore, boards of directors and management should view a healthy capital structure (debt) not only as a source of funding but also as a natural oversight mechanism that can promote operational transparency. Finally, companies need

to reform the function of audit committees from merely symbolic compliance to strategic risk assessments, ensuring that their members have literacy and backgrounds in tax law to maintain the company's reputation and capital market confidence.

Recommendations for Future Research: Subsequent studies should explore the nuances of how the audit committee's effectiveness in moderating the relationship between financial leverage and tax avoidance may be influenced by various organizational factors, such as internal governance mechanisms and ownership structures. A deeper understanding of these contextual factors could offer valuable insights for policymakers and banking institutions on optimizing the audit committee's role in enhancing tax compliance and financial stability.

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ESG, GREENWASHING AND DIGITAL TRACEABILITY IN THE TEXTILE VALUE CHAIN: A BIBLIOMETRIC REVIEW AND CAPITAL-MARKET RISKS FOR EMERGING ECONOMIES

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ABSTRACT

Despite the growing scrutiny on environmental, social, and governance (ESG) practices within the global textile sector, existing literature remains fragmented regarding how greenwashing and measurement frictions propagate into capital market information risk, particularly in ASEAN emerging economies. This study addresses this gap and maps the research frontier at the intersection of ESG, greenwashing, and the textile value chain. Using a PRISMA-guided systematic review of Scopus-indexed publications (2000–2025), we conduct bibliometric and content analyses with VOSviewer and Bibliometrix, incorporating robustness tests for threshold and clustering choices. Corresponding to our research objectives, the results indicate: (i) a significant trajectory of interest evidenced by a sharp post-2020 publication surge; (ii) the identification of four thematic clusters: consumer legitimacy and direct/vicarious greenwashing; ESG metrics, governance drivers and assurance; traceability, circularity and digital technologies in multi-tier supply chains; and verification, risk and market consequences; and (iii) critical evidence that rating disagreement and opacity in wet-processing tiers intensify information risk where disclosure and audit capacity are weak. We contribute a replicable knowledge map, an integrative disclosure–assurance framework, and facility-verifiable "say–do" indicators to support research and governance of sustainability-linked investment.

Keywords: ESG; greenwashing; textile value chain; PRISMA, Bibliometric.

JEL: Q56; M14; G14; L67; G15

INTRODUCTION

The textile and apparel industry provides a stringent test case for environmental, social, and governance (ESG) governance because production is simultaneously resource intensive and dispersed across multi-tier global value chains (Mashaphu et al., 2024). Environmental externalities remain material: existing evidence suggests that the fashion system generates substantial waste and water consumption on an annual basis (Niinimäki et al., 2020). These impacts are not evenly distributed along the chain. Upstream "wet-processing" activities—particularly dyeing and finishing—are frequently associated with complex effluents containing persistent colourants, salts, and heavy metals that are costly to monitor and treat

(Al-Tohamy et al., 2022). At the same time, industry organisation characterised by outsourcing and multiple supplier tiers limits observability beyond first-tier facilities, weakening the effectiveness of purely firm-level disclosure as a mechanism of accountability. This combination of high externalities and low visibility makes the sector an instructive setting for studying how ESG information is produced, interpreted, and potentially distorted.

In capital markets, ESG information is increasingly used to assess long-run risk, managerial quality, and value creation (Kim & Kiymaz, 2025). Yet the informational infrastructure supporting ESG assessments remains imperfect. A prominent manifestation is the low agreement across ESG ratings for the same firm. Berg, Kölbel, and Rigobon (2022) show that rating divergence can be traced to systematic differences in scope (what is measured), measurement (how attributes are operationalised), and weighting (how attributes are aggregated). Such divergence is not merely methodological; it has implications for how investors and intermediaries interpret ESG signals. Evidence indicates that greater disagreement in ESG assessments is associated with higher stock return volatility and broader dispersion in market expectations (Christensen et al., 2022). Related work suggests that when rater disagreement is large, the predictive content of aggregate ESG ratings for subsequent ESG news and market reactions weakens (Serafeim & Yoon, 2023). In multi-tier supply chains such as textiles—where salient impacts and compliance risks are often upstream and weakly captured by public reporting—measurement noise may be amplified, increasing information asymmetry and complicating the disciplining role of markets.

These conditions also heighten the risk of greenwashing. Greenwashing refers to communications that misrepresent environmental (and, more broadly, sustainability) performance through exaggeration, selective disclosure, or ambiguity (Delmas & Burbano, 2011). Organisational accounts of legitimacy and policy–practice "decoupling" explain how formal commitments may yield reputational benefits even when implementation is incomplete (Bromley & Powell, 2012). In supply chains, misalignment can extend beyond firm boundaries: downstream brands may communicate sustainability targets while non-compliant practices persist at supplier sites where monitoring is limited. Pizzetti, Gatti, and Seele (2021) conceptualise "vicarious greenwashing" as a form of blame displacement in which supplier behaviour contradicts corporate sustainability claims but accountability remains diffuse. For the textile and apparel sector—where environmental harm and labour vulnerabilities often concentrate in upstream tiers—this "say–do" gap is of particular relevance for both governance and investment decisions.

In response, recent research has developed two partially overlapping agendas: strengthening transparency through governance and reporting mechanisms and enabling traceability through digital infrastructures. A bibliometric synthesis of supply chain transparency research highlights rapid growth and increasing emphasis on the integration of technology with governance frameworks (Montecchi et al., 2021). Within textiles, traceability architectures, including blockchain-based designs, have been proposed to support multi-tier information sharing and improve auditability (Agrawal et al., 2021). On the reporting side, third-party ESG assurance has been advanced as a credibility-enhancing mechanism, although evidence indicates substantial heterogeneity in assurance scope and form, with implications for users of ESG information (Gipper et al., 2025).

Despite these advances, important gaps remain. First, finance and accounting research on ESG measurement and rating divergence has largely evolved separately from operations and supply chain research on transparency and traceability. This separation limits understanding of how capital-market incentives interact with upstream operational realities in multi-tier production systems. Second, existing reviews rarely organise evidence at the intersection of (i) ESG dimensions (E–S–G) and (ii) supply chain tiers and stages, even though materiality, verifiability, and responsibility differ across stages such as wet processing, cut-make-trim, and retail. Third, while "say–do" gaps are frequently invoked, the literature remains dispersed regarding facility-verifiable indicators that could be used to audit claims and link them to economically meaningful outcomes (e.g., risk, financing conditions, investor responses, and labour

welfare).

This paper addresses these gaps through a systematic, multi-method review of research on ESG, greenwashing, and the textile supply chain. Using a PRISMA-guided search and screening process, we combine bibliometric techniques (e.g., co-citation analysis and bibliographic coupling) with a structured content analysis. Building on recent bibliometric work on ESG and greenwashing (Bhullar et al., 2025), we extend the synthesis to the textile and apparel value chain and develop an ESG × supply-chain-tier matrix to identify (a) where greenwashing risks are theorised to arise and (b) how the literature operationalises "say–do" discrepancies. The review contributes by (i) mapping the intellectual structure of this interdisciplinary field, (ii) integrating capital-market and supply-chain perspectives into a unified analytical framework, and (iii) consolidating candidate, tier-specific indicators emphasising facility-level verifiability—particularly for upstream wet-processing stages—thereby supporting future empirical work on the economic and social consequences of greenwashing.

Accordingly, the study is guided by the following research questions:
RQ1 (Publication dynamics): How has research on ESG and greenwashing in the textile supply chain evolved over time in terms of volume, outlets, and methodological approaches?
RQ2 (Intellectual structure): Which journals, authors, institutions, and countries constitute the field's core, and what knowledge bases underpin its development?
RQ3 (Themes and operationalisation): What thematic clusters dominate the literature, and what greenwashing mechanisms and tier-specific indicators are emphasised across ESG dimensions and supply chain stages?

The remainder of the paper is structured as follows. Section 2 describes the data collection and review methodology. Section 3 presents the bibliometric results and content analysis, discusses implications for theory and measurement, and outlines directions for future research relevant to emerging-market supply chains. Section 4 concludes.

METHODOLOGY

This study employs a systematic literature review (SLR) methodology to thoroughly analyze and synthesize existing research within the field. Utilizing the structured framework proposed by Durach et al. (2017), the review process is divided into four critical stages, each contributing to the comprehensiveness and systematic nature of the analysis. This methodical approach ensures a clear and replicable process, serving as a valuable resource for future reviews in the domain.

To further strengthen the rigor of the study, the PRISMA framework (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was adopted, as detailed by Page et al. (2021). PRISMA is a widely recognized set of guidelines designed to enhance transparency, consistency, and reliability in systematic reviews and meta-analyses. By adhering to this framework, the study aims to minimize bias and improve the validity of its findings. PRISMA offers a structured reporting method that ensures clarity in documenting each step of the review process. This not only improves the quality of the synthesis but also bolsters its reliability, as supported by later works (Aggarwal et al., 2025; Bhullar et al., 2025; Nguyen et al., 2025).

The Scopus database was utilized for bibliographic data collection on September 19, 2025, due to its extensive coverage of peer-reviewed research across diverse disciplines. Renowned for its rigorous indexing standards, Scopus employs the SCImago Journal Rank (SJR) indicator to assess journal quality based on citation metrics and the prestige of citing journals. This makes it a reliable source for identifying influential and high-quality studies, aligning perfectly with the requirements of a systematic review.

The search string was constructed based on core terms related to greenwashing and ESG, combined with keywords specific to the textile industry. The initial keyword set referenced the terms used by Bhullar et al. (2025) ("Greenwashing", "ESG", "ESG Ratings", "ESG Investments", "Green Finance", "Greenwashing Regulations") and was expanded for the textile context: ("greenwash*" OR "ESG") AND (textil* OR apparel OR garment* OR fashion).

Scopus also provides a bulk bibliographic reference download feature, which significantly enhances efficiency in large-scale reviews. This capability ensures comprehensive access to relevant studies, including those published in smaller or less prominent journals that may still offer valuable insights. By leveraging this feature, the review process was streamlined and broadened to encompass a wide range of perspectives and findings within the field.

The systematic review process described emphasizes the importance of adhering to predefined criteria to ensure the inclusion of high-quality and relevant studies. It begins with a thorough search in the Scopus database, utilizing carefully chosen keywords to capture a wide range of research types, including empirical studies, theoretical discussions, and methodological papers. Following the initial search, studies are rigorously screened based on publication date, relevance to research questions, journal quality, and methodological rigor. This meticulous process helps narrow down the selection to studies that best align with the review's focus.

After selecting the studies, a two-step data extraction and synthesis process is employed. The first step involves gathering bibliographic details like authors, publication year, title, journal, and abstract, enabling the organization of studies by themes and research questions. The second step entails an in-depth analysis of each study's content, focusing on methodologies, findings, and theoretical contributions. This comprehensive analysis is instrumental in understanding current research trends, identifying areas of consensus, and highlighting gaps or disagreements within literature.

The systematic review conducted emphasizes transparency and replicability at every stage, ensuring the process is meticulously documented for ease of reproduction by other researchers. By minimizing bias and maintaining methodological integrity, the review highlights significant trends in literature while identifying areas for future exploration. Following Durach et al. (2017) four-stage framework, the process began with planning, where research questions, inclusion/exclusion criteria, and search strategies were defined. The searching stage involved utilizing the Scopus database to identify relevant studies based on predefined criteria. During the analysis stage, data extraction and synthesis were carried out to uncover key themes and patterns. Finally, the reporting stage presented these findings in a structured and coherent manner.

This systematic approach not only ensures the review is comprehensive and methodologically robust but also contributes valuable insights to the existing body of knowledge. By adhering to established frameworks, the review serves as a foundational resource for scholars and practitioners alike, offering a clear synthesis of existing research while pinpointing gaps that warrant further investigation. The findings are grounded in high-quality peer-reviewed studies, making this review a reliable tool for navigating complexities in the field and inspiring future research efforts.

The research process began with an initial search in Scopus, articles directly related Greenwashing, ESG and textile which identified 215 records. Additional filters were then applied, eliminating 66 non-peer-reviewed documents such as conference papers and book chapters. A language filter was subsequently used to retain only English-language articles, further narrowing the selection to 8 articles. Finally, a manual review of titles and abstracts was conducted to ensure alignment with the research questions. After all these steps, the final sample comprised 141 articles.

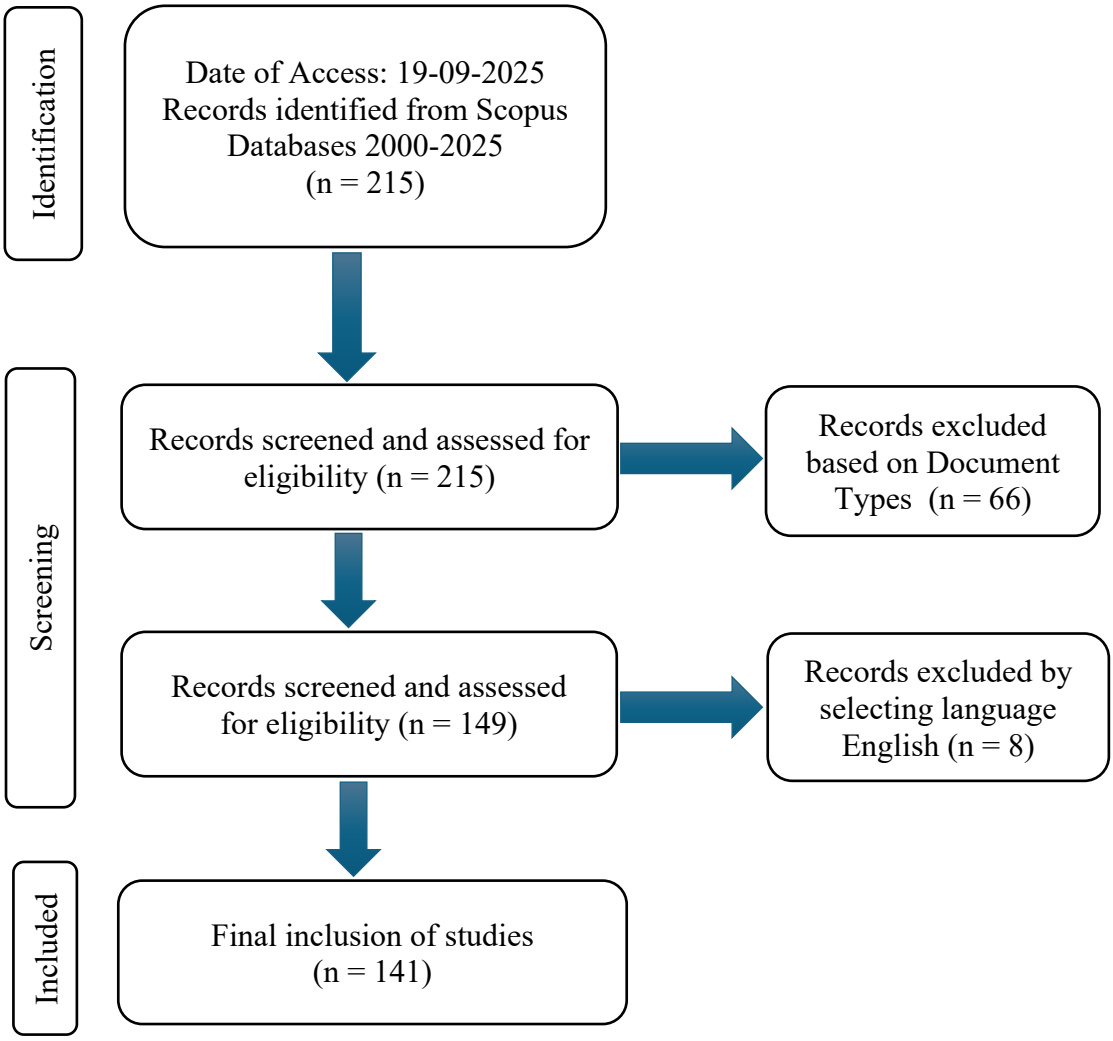

Figure 1. PRISMA flowchart of the study selection process.

RESULTS

Publication Trends (RQ1)

The chart illustrates the fluctuations in annual scientific production, as measured by the number of articles published each year. Between 2000 and 2010, the output remained relatively low, with only a handful of articles appearing annually. This period might suggest that the field, or perhaps the institutions involved, were still in a formative phase, perhaps constrained by limited resources or a lack of clear research priorities. It's around 2011 that the trend starts to shift. The increase in publications, though gradual, seems to imply that interest in the field was growing, likely spurred by factors such as additional funding, more developed research infrastructure, or perhaps a subtle shift in focus. By 2017, however, the landscape changes dramatically, with a surge in research output. There is a sharp spike around 2020, continuing through 2023, which could indicate that something more significant is driving this growth. While the reasons for this uptick are not entirely clear, it is possible that technological advancements, a greater emphasis on international collaborations, or an influx of funding played a role. It's also plausible that a particular area of research suddenly gained prominence, capturing both academic and public interest. The

sharp rise between 2022 and 2023, in particular, seems to point toward a major breakthrough, potentially linked to an emerging scientific issue or a response to global events or societal needs. These years may represent a turning point in the field, reflecting a combination of external pressures and internal innovations that catalyzed the surge in productivity.

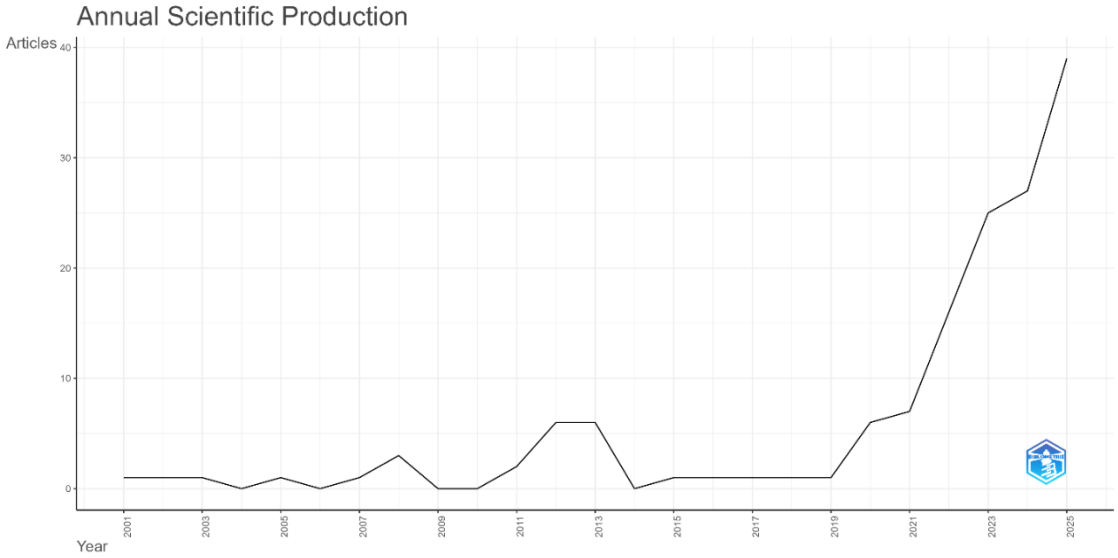

Figure 2. Publication trends by year (2000–2025)

Influential Actors (RQ2)

We looked at the major players shaping this research area, considering things like influential journals, top countries, key authors, and the articles that have had the most impact

Table 1. Top 10 Most Influential Journals

Rank	Journal	Article	Total Citations
1	Journal of Cleaner Production	6	477
2	Journal of Fashion Marketing and Management	3	334
3	Sustainability (Switzerland)	13	195
4	Corporate Social Responsibility and Environmental Management	1	58
5	Resources, Conservation and Recycling	1	38
6	Business Ethics, the Environment & Responsibility	1	16
7	Telecommunications Policy	1	7
8	Frontiers in Environmental Science	1	7
9	Environment, Development and Sustainability	1	6
10	International Journal of Fashion Design, Technology and Education	1	3

Source: statistical authors

The *Journal of Cleaner Production* was arguably one of the most prominent publications in the sustainability and environmental management space, leading the charge with six articles that collectively have been cited 477 times. Among these, the work by Rausch and Kopplin (2021), titled "Bridge the gap: Consumers' purchase intention and behavior regarding sustainable clothing" stands out with a staggering 366 citations. This suggests that their research had had a notable influence in the field.

In second place, *Journal of Fashion Marketing and Management* has published three articles, which together have earned 334 citations, while *Sustainability* takes third with thirteen articles, totaling 195 citations. Interestingly, *Corporate Social Responsibility and Environmental Management* ranks fourth with one article that have accumulated 58 citations—demonstrating a somewhat more modest, though still significant, impact.

Elsevier appears to have a dominant presence, publishing half of the top 10 most-cited journals in this area, which underscores its substantial contribution to the advancement of ESG, greenwashing and sustainability. It is also worth noting that all of these journals are indexed in SCOPUS databases, tools that help researchers gauge the credibility and scholarly impact of various publications. Perhaps what's most remarkable is that every article in the top 10 belongs to SCOPUS's Q1 quartile, suggesting that they represent the highest quality of academic work in this field.

Rausch and Kopplin (2021) have produced what is widely regarded as the most influential work in Garment industry; Purchasing; Sales; Sustainable development; Textile industry. Their research, which focused on bridge the gap: Consumers' purchase intention and behavior regarding sustainable clothing, analyzed a sample of four hundred sixty-four participants were inquired to assess these constructs in the context of sustainable clothing. Their findings indicate that attitude towards sustainable clothing has the highest impact on purchase intention. However, this relation is negatively influenced by consumers' greenwashing concerns. Moreover, we find evidence that consumers' perceived aesthetic risk negatively impacts the intention-behavior relation, whereas perceived economic risk has no significant effect on this relation. The second most-cited article, authored by Henninger et al. (2016), garnered 334 citations. Their study, which examined what the term sustainable fashion means from the perspective of micro-organisations, experts, and consumers. This research was qualitative in nature, utilising a multi-methods case study approach (semi-structured interviews, semiotics, questionnaires). Grounded analysis was applied to analyse the data. Findings indicated that interpretation of sustainable fashion is context and person dependent. A matrix of key criteria provides the opportunity to find common elements. Beyond these two seminal works, several other highly cited studies contribute to the growing body of literature on these topics. For instance, Sailer et al. (2022) greenwashing and Bluewashing in Black Friday-Related Sustainable Fashion Marketing on Instagram, while Lu et al. (2022) young Consumers' Greenwashing Perception Impact Their Green Purchase Intention in the Fast Fashion Industry. Liu et al. (2023) explored data-driven ESG assessment for blockchain services: A comparative study in textiles and apparel industry.

Table 2. Top 10 Most Productive Countries

Rank	Country	Article	Percentage (%)
1	China	47	14.5
2	Spain	43	13.2
3	Germany	33	10.1
4	United Kingdom	32	9.8

5	United States	32	9.8
6	Italy	21	6.4
7	South Korea	19	5.8
8	Canada	17	5.2
9	Mexico	17	5.2
10	Malaysia	12	3.7

Source: statistical authors

Table 2 showed a relatively diverse distribution of Q1 publications across countries, with China leading the pack at 47 articles (14.5%), followed by Spain (43) and Germany (33). Together, these three countries account for nearly 38% of the total output. However, when expanding to include the UK and the USA, each with 32 articles, the combined share rises to about 58%. While this is significant, it still falls short of the 80% threshold often associated with the Pareto principle, which typically highlights the dominance of a few key contributors. This finding may suggest that Q1 publications are more evenly spread across nations than is often assumed. Regionally, Europe emerges as a major contributor, representing roughly 44% of total publications, with Spain, Germany, the UK, Italy, and the Czech Republic leading the way. Asia follows with 24%, largely driven by China and South Korea. The Americas make up about 20%, with the USA, Canada, and Mexico sharing the load fairly evenly. Notably, Mexico's publication volume is on par with that of Canada, which could point to an emerging strength in Latin American research—something worth considering when thinking about future trends. The "Others" category, though accounting for 12%, hinting at a more widespread engagement with Q1 publications than might be expected

Emerging Themes (RQ3)

Multiple Correspondence Analysis (MCA) examined the relationships between categorical variables, it may be useful to consider the distances between keywords as indicative of their contextual closeness. Fig 3 appears to reveal two prominent poles along an underlying axis. On the left, one cluster likely captures the marketing-consumer-CSR narrative within fashion, with keywords like communication, marketing, social media, and sustainability (including the controversial fast fashion). This positioning hints at a long-standing academic fascination with how companies convey sustainability messages and how consumers respond to them, particularly in the context of a rapidly shifting market. Meanwhile, on the right side, we observe a concentration around the governance of industry and the measurement of ESG (Environmental, Social, and Governance) factors. Keywords such as textile industry, transparency, ESG reporting, and environmental technology suggest a growing push for more standardized frameworks for ESG disclosure and verification. What's particularly striking is how greenwashing and sustainability appear at the very center of the map, functioning as critical nodes that bridge the two larger poles. Concepts like sustainable development, circular economy, and ESG reporting serve as important intermediaries, facilitating connections between the more established concerns about marketing and consumer perception and the rising focus on corporate responsibility and governance.

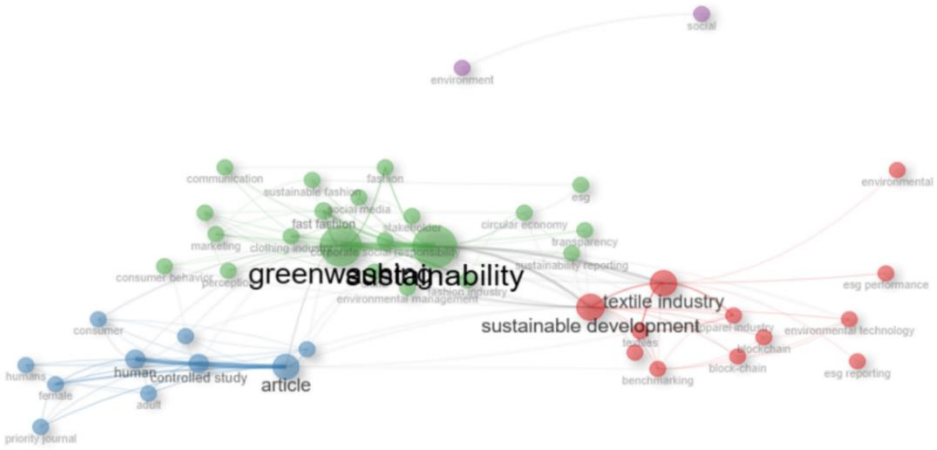

Figure 3. A conceptual Multiple Correspondence Analysis (MCA)

Thematic Clusters from Bibliographic Coupling

Figure 4 illustrates the key thematic clusters identified through bibliographic coupling using VOSviewer software. The figure shows a network visualization of the clusters, with different sizes and colors representing their significance

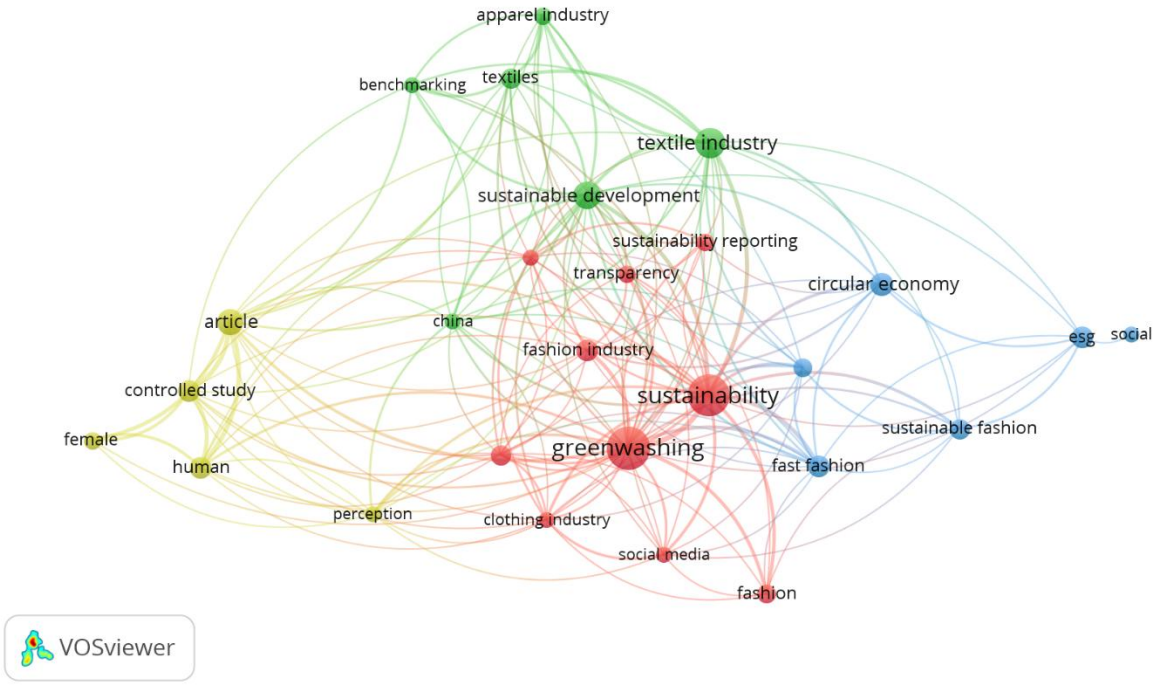

Figure 4. The conceptual bibliographic coupling

The conceptual bibliographic coupling analysis reveals three distinct thematic clusters, offering a detailed view of the research landscape.

Cluster 1: Greenwashing and Sustainability in the Fashion Industry: Transparency, Environmental Management, and Social Responsibility

The red cluster in Figure 4 highlights 5 studied that explored the interconnected themes of amassing a total of 866 citations. Among these, the studied by Rausch and Kopplin (2021) stands out as the most influential, with 366 citations, attitude towards sustainable clothing has the highest impact on purchase intention. However, this relation is negatively influenced by consumers' greenwashing concerns. Moreover, consumers' perceived aesthetic risk negatively impacts the intention-behavior relation. Henninger et al. (2016), cited 334 times, emphasized interpretation of sustainable fashion is context and person dependent. Sailer et al. (2022), with 8 citations, discovered that consumers' critical attitude towards Black Friday and high ad skepticism predicted positive evaluations while sustainable purchase behavior predicted negative evaluations, showed a general concern for the environment and issues of social sustainability. Kim and Oh (2020), cited 58 times, contributed to the literature by applying in-depth analysis of consumer associations of fast fashion brands from a sustainability perspective through network analysis. Additionally, Mulligan et al. (2024), cited 7 times, reveal that Blockchain technology has been proposed to achieve sustainable development through various solutions, such as carbon credit trading, energy systems and supply chain management.

Cluster 2: Sustainable in the Textile and Apparel Industry: Prospects and Practices

Comprising 5 articles with a total of 75 citations, this cluster includes notable studies. Liu et al. (2023) (38 citations) found that proposed data-driven ESG assessment approach can analyze the companies' sustainability performances and benchmark the sustainability level of the company in the peer industry. Tolentino-Zondervan and DiVito (2024) (16 citations) examined Dutch textile and apparel firms predominantly communicate the environmental, to a lesser extent social, and least of all economic sustainability factors. Besides, the use of technological keyword indicators is less prominent, while certain technologies such as IoT, sensors and blockchain correlate mostly to environmental sustainability factors. Moreover, qualitative analysis reveals that to address sustainability via digitalization, it is important to link sustainability goals to Key Performance Indicators, which requires data for traceability. Zhu et al. (2025) (16 citations) revealed a positive relationship between gender diversity and ESG performance. Similarly, a positive relationship was found between board independence and ESG performance. Contrarily, an inverse connection was found between board size and ESG performance, as well as CEO duality and ESG performance. Yu et al. (2023) (7 citations) was confirmed that the items on the ESG practices scale significantly affected a fashion brand's reputation and consumer intention to purchase that brand as mediated by reputation. Finally, Mousavi et al. (2024) (6 citation) found that the use phase and manufacturing have the most significant environmental impacts. The simulation resulted unequivocally illustrate that the implementation of eco-labeling practices across various textile industries can yield remarkable improvements in environmental sustainability, surpassing the 90% mark. Furthermore, the environmental impact assessment underscores that the most significant environmental impacts are primarily concentrated in the usage and manufacturing phases

Cluster 3: Fast Fashion and Social Marketing: The Impact of ESG and Circular Economy on Sustainable Fashion

Cluster 3 with a total of 566 citations. Key studies in this cluster include Henninger et al. (2016), Sailer et al. (2022), Shakil (2022), Kim and Oh (2020) and Wu et al. (2022)

Henninger et al. (2016) with 344 citations, Sailer et al. (2022) with 8 citations, Kim and Oh (2020) with 58 citations, Shakil (2022), with 58 citations, contributed to the research domain of ESG and risk by presenting the significant influence of ESG on stock price volatility in the textile and apparel industry. Wu et al. (2022) with 56 citations, proposed an architecture of smart ESG reporting platform leveraging the Internet of Things (IoT) and blockchain technologies to enable corporate crowdsensing for environmental data and enhance the security, transparency and creditability of ESG reporting process.

Cluster 4: Perception of Human Behavior in Females: Insights from a Controlled Study

The yellow cluster in Figure 4 highlights 5 studied that explored the interconnected themes of amassing a total of 70 citations.

Lu et al. (2022) (40 citations) found that (1) consumers' perception of greenwashing in the fast fashion industry had a direct negative effect on their green purchase intention; (2) greenwashing perception had an indirect negative effect through consumers' risk perception, including financial perceived risk and green perceived risk; (3) consumers' impulsive buying in the fast fashion industry reinforced the positive effect of greenwashing on their financial risk perceptions as a moderating variable. Munir and Mohan (2022), with 23 citations, greenwashing had not been examined in the United Arab Emirates, and the fashion sector was considered the second largest consumer of harmful chemicals, excessive water use, and non-compliant waste management practices behind the oil and gas sector. Fang (2024), with 4 citations, indicated that the relationship between green social media influence, greenwashing perception, and green authenticity perception remains significant. Similarly, the mediating relationship of green authenticity perception between green social media influence and green purchase decisions remains significant. However, the mediating relationship of greenwashing perception between green social media influence and green purchase decisions remains non-significant. Diaz-Bustamante-Ventisca et al. (2025), with 3 citations, showed that consumers perceive greenwashing in the communication of all fast-fashion brands. Furthermore, the perception of greenwashing was higher when it is associated with the search for information on sustainable fashion, as well as the purchase of sustainable fashion.

DISCUSSION

The research delves into the complexities of greenwashing, presenting critical insights across diverse academic disciplines. Through a comprehensive bibliometric analysis of existing literature in the ESG and greenwashing domains, the study aims to address three key areas. First, it explores publication trends to understand the volume and nature of prior research conducted (RQ1). Second, it identifies influential contributors, including journals and authors with significant citation impact (RQ2). Finally, it uncovers emerging themes, highlighting key academic research areas gaining prominence in this field (RQ3).

The findings suggest that there's been a noticeable uptick in academic interest around topics like greenwashing and ESG, especially when you look at the sharp rise in publications from 2000 to 2024. This growing attention spans a variety of areas, including ESG, sustainable fashion, clothing industry**,** transparency, corporate social response, environmental management. Among the journals, the *Journal of Cleaner Production* stands out as the most-cited, with 477 citations. This could be due to its strong focus on cleaner production and sustainability, which are hot topics right now. In second place is *Journal of Fashion Marketing and Management*, with 334 citations, likely because it zeroes in on marketing and management —another increasingly important area in the ESG conversation. *Sustainability (Switzerland)* follows closely with 60 citations. It's interesting to note that Elsevier seems to have a strong presence in this field, as five of its journals appear in the top ten most-cited list, which may point to its significant influence in shaping the discourse around these critical topics.

China has the highest number of articles at 47, with Spain coming in second at 43, and Germany in third place with 33. This suggests a dominant role for these three countries in shaping the discourse around ESG disclosures and business-related greenwashing practices. While this may reflect their larger economic influence, it could also point to a strategic emphasis on these issues given their global economic and environmental footprint.

FUTURE RESEARCH DIRECTIONS

To advance the scholarly discourse on ESG and greenwashing, future research should prioritize cross-sectoral generalization and cross-cultural dynamics to validate the proposed framework beyond the specific context of the textile industry. While this study provides a foundation within the apparel value chain**,** empirical testing is needed in other high-externality sectors such as electronics, fast-moving consumer goods (FMCG), and extractive industries (mining and oil) to determine if disclosure frictions remain consistent across different production structures. Specifically**,** scholars are encouraged to investigate how institutional environments and cultural values—such as the dichotomy between collectivism and individualism—influence consumer skepticism and investor reactions to sustainability signals (Sailer et al., 2022). Future work should examine the role of "institutional voids" in emerging ASEAN markets compared to the more regulated European Union (EU) to understand how the lack of stringent enforcement may incentivize symbolic compliance. From a financial perspective**,** research should transition toward measuring global capital market efficiency, testing whether greenwashing allegations drive significant mispricing in emerging versus developed markets (Shakil, 2022). Finally**,** as international bodies strive for harmonized standards (e.g., ISSB, ESRS), comparative studies across different legal systems (Civil Law vs. Common Law) are essential to evaluate the cost-effectiveness of mandatory ESG assurance (Wu et al., 2022). Such multidimensional efforts will facilitate the development of a generalized theory of corporate sustainability that transcends industry-specific silos and national borders.

THEORETICAL IMPLICATIONS

The study offers some interesting insights into Environmental, Social, and Governance (ESG) practices. It seems to focus mainly on how companies report these initiatives and the potential pitfalls, like greenwashing. While ESG reporting is often touted as a way to hold businesses accountable, there's a real risk that some companies might exaggerate their efforts, which could end up misleading consumers and investors. This could have far-reaching consequences, not just for businesses but for society as a whole. First, the map supports a "three-ring" model: the core ring is *sustainability* ↔ *greenwashing* (language/meaning), the middle ring is *reporting–transparency–benchmarking* (institutions), and the outer ring is *ESG–circular* (strategy and finance). An effective analytical frame should view greenwashing as movement across these rings rather than a binary true/false state. Secondly, the intersection of *social media* with *transparency* invites an extension of signaling theory: green messages build reputational capital only when paired with hard-to-fake signals—fiber origin data, plant-level traces, or lifecycle verification. Thirdly, the limited connectivity of *ESG* suggests the need to fuse two still-separate streams—financial ESG and sectoral sustainability—into an "accounting–markets bridge," consistent with the sample article's focus on reducing information asymmetry and improving price efficiency. Overall, green-claims regulation is most effective when coupled with minimum data standards and incentives for independent assurance, while also harmonizing sectoral sustainability standards with capital-market ESG disclosure rules.

CONCLUSION

This research synthesizes the complex nexus of ESG paradigms, greenwashing phenomena, and digital traceability within the textile value chain, with a specialized focus on the structural vulnerabilities of emerging economies. To provide clarity on the paper's contributions, this section delineates the study's findings by

systematically resolving the three primary research questions (RQs), supported by contemporary academic literature.

RQ1 (Publication dynamics): The longitudinal evolution of scholarship

The bibliometric inquiry reveals an exponential upward trajectory in scholarly output post-2020, signaling a global shift toward critical scrutiny of corporate sustainability mandates. The discourse has matured from generalist management platforms to specialized high-impact outlets, indicating a transition toward technical transparency and supply chain integrity. Methodologically, the field has progressed from exploratory qualitative inquiries to sophisticated quantitative analyses, utilizing large-scale data mapping and systematic content evaluation. This evolution reflects an academic imperative to move beyond anecdotal critiques toward capturing the structural "disclosure frictions" observed in recent sustainability reporting trends.

RQ2 (Intellectual structure): Core contributors and theoretical foundations

The intellectual landscape is defined by a multi-nodal collaborative network, where developed-market scholarship increasingly converges with empirical insights from pivotal production hubs such as China and Vietnam. Core publishing houses serve as the primary epistemic facilitators, while the field's theoretical underpinnings are firmly rooted in Institutional and Stakeholder Theories. The analysis demonstrates that the discipline's growth is fueled by a convergence of environmental science and corporate finance, shifting the focus from "reputational aesthetics" to "risk-based ESG valuation" (Shakil, 2022). This intellectual core provides a robust theoretical bridge for understanding how institutional voids in emerging markets create systemic vulnerabilities for global investment portfolios.

RQ3 (Themes and operationalisation): Thematic taxonomy and greenwashing mechanisms

A granular examination identifies three dominant pillars: ESG performance metrics, the mechanics of greenwashing, and the corrective potential of digital traceability. A seminal contribution of this study is the conceptualization of "vicarious greenwashing," predominantly localized in the opaque upstream tiers (Tier 2 and Tier 3) of the supply chain. The findings highlight that operationalization remains fragmented; downstream tiers emphasize consumer-centric social metrics, whereas upstream stages are plagued by environmental non-compliance (Tolentino-Zondervan & DiVito, 2024). Crucially, the lack of harmonized, tier-specific indicators facilitates a "transparency gap," allowing firms to mask production-stage externalities. However, the integration of blockchain-enabled platforms offers a technical solution to mitigate information asymmetry and enhance accountability (Wu et al., 2022).

Concluding Remarks and Strategic Implications

In summary, this study transitions the greenwashing debate from a qualitative critique to a strategic risk assessment. For practitioners, the findings underscore that institutional resilience requires a transition from symbolic reporting to substantive, technology-enabled verification to immunize firms against the financial fallout of systemic supply chain risks. For the academic community, this review establishes a rigorous baseline for future longitudinal investigations into the efficacy of mandatory ESG reporting standards on global capital market efficiency.

The limitations of this review include its inherent language (English) and database (Scopus). Despite these limitations, the core conclusions are clear: to bridge the "say-do gap" in the textile industry, it is essential to raise the cost of signal falsification—through physically-grounded assurance mechanisms and multi-tier traceability—while simultaneously reducing measurement noise via indicator standardization. Once these conditions are met, the market will be better able

to distinguish credible from non-credible signals, and firms will be incentivized to shift from merely symbolic commitments to a model of verifiable sustainability.

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NAVIGATING THE VUCA LANDSCAPE: THE ROLE OF ARTIFICIAL INTELLIGENCE IN EMPOWERING RESOURCE-CONSTRAINED SMES IN AFRICA

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ABSTRACT

Small and medium-sized enterprises (SMEs) are central to Africa's economy but face persistent challenges in volatile, uncertain, complex, and ambiguous (VUCA) environments. This study examines how Artificial Intelligence (AI) can support resource-constrained SMEs in enhancing resilience, efficiency, and competitiveness. Drawing on a systematic literature review of 95 peer-reviewed articles and bibliometric analysis, the paper map's key themes and trends in AI adoption among African SMEs. Findings show that AI applications such as predictive analytics, chatbots, and automation are mainly used to improve efficiency, agility, and decision-making, though adoption is constrained by high costs, limited skills, and weak infrastructure. Guided by the Resource-Based View and Diffusion of Innovations frameworks, the analysis positions AI both as a strategic resource and as a socially embedded innovation. The study contributes by highlighting policy priorities digital infrastructure, regulatory clarity, and incentives and practical strategies for capacity-building and ecosystem partnerships to foster sustainable SME development.

Keywords: Artificial Intelligence, SMEs, Africa, VUCA, Resilience

INTRODUCTION

In Africa, small and medium-sized enterprises (SMEs) represent approximately 90% of all businesses and play a critical role in driving economic development, creating jobs, and reducing poverty. For example, a local bakery in Kenya implemented artificial intelligence (AI) to analyse customer preferences and optimize its inventory management. As a result, this bakery not only tripled its revenue in two years but also created ten new jobs, significantly impacting the local community (Mwangi, 2024). Such success stories exemplify the transformative potential of AI amidst the volatile, uncertain, complex, and ambiguous (VUCA) landscape characterizing the continent's business environment.

Despite their significance, African SMEs face formidable challenges, including limited access to finance, inadequate infrastructure, and a lack of skilled labour. In this VUCA context, which includes rapid market changes and unpredictable economic conditions, maintaining operational efficiency is increasingly difficult. However, AI offers unparalleled opportunities for these enterprises to enhance their adaptability and competitiveness. By leveraging AI technologies, businesses can streamline operations, forecast market trends, and personalize customer experiences, thereby transforming data into actionable insights that drive strategic decision-making (Musyoka & Ouma, 2024).

Despite the clear advantages of AI, the literature on its adoption among African SMEs remains limited. This gap is particularly pronounced when considering the unique socio-economic challenges that hinder the integration of advanced technologies in resource-constrained environments. While numerous studies highlight the benefits of AI, few explore how these technologies can be effectively adapted to the specific needs and circumstances of African SMEs operating in a VUCA landscape. Thus, this paper will contribute to filling this knowledge void through a systematic literature review (SLR) and bibliometric analysis, focusing on how AI can empower resource-constrained SMEs in Africa.

To guide this exploration, the study will address two central research questions:
1.What specific AI technologies and applications can resource-constrained SMEs in Africa leverage to enhance their operational efficiency and responsiveness in a VUCA environment?
2. What barriers hinder the effective adoption of AI technologies among African SMEs, and what strategies can be implemented to overcome these challenges?

By examining these questions, this paper aimed to elucidate the transformative impact of AI on African SMEs, emphasising that empowering these businesses transcended mere technological enhancement; it was a critical pathway towards fostering sustainable economic growth and improved social outcomes across the continent.

This study focuses on how artificial intelligence can transform Africa's under-resourced small and medium-sized enterprises (SMEs). To understand this complex transformation, the review of mainstream literature highlights two relevant theories: the Resource-Based View (RBV) and the Diffusion of Innovations (DOI). Both theories lay the foundation for how AI technologies can increase SMEs' competitive performance and elucidate the trajectory and determinants necessary to do so.

The Resource-Based View, as introduced by Wernerfelt (1984) and later developed by Barney (1991), emphasizes a firm's resources and capabilities in developing competitive advantages that are not simultaneously being implemented by current or potential competitors. AI serves as a technology resource for African SMEs, profoundly improving operations and competitive outcomes. For example, a small agri-tech company in Ghana saw crop yields rise by 30% using AI and achieved a 20% cost reduction. By enhancing external market-driven responses, AI integration enables SMEs to compete effectively under restricted conditions. Furthermore, according to the RBV, it is essential to develop internal capacities to implement AI correctly. Such capabilities necessitate capacity-building initiatives, including training workers in data analytics and artificial intelligence (Smith et al., 2025). Moreover, the RBV asserts that differences in resources, such as specialized data, technological infrastructure, and licensed human resources, may influence the speed and success with which SMEs embrace AI. It is critical to recognize and resolve resource variations to promote broader AI implementation across the continent.

To capture the final major theory of innovation, the Diffusion of Innovations model comes to the fore. Rogers (1962) introduced this framework, which exposes characteristics influencing AI acceptance by SMEs in Africa. This theory describes how new technologies are leveraged across organizations based on communication channels and social systems, while also focusing on innovation-related attributes. Five attributes relative advantage, compatibility, complexity, trialability, and observability within the DOI framework are believed to either impede or foster the adoption of AI technologies.

For instance, SMEs will be more predisposed to integrate AI into their operations if they perceive substantial relative advantages such as improved customer service via AI chatbots or increased operational efficiencies. Conversely, if the implementation complexity is perceived as excessive or operational costs outweigh benefits, adoption will lag (Kedi et al., 2024). The DOI theory also suggests that the local epistemic community and engaged actors play a significant role in spreading AI knowledge and

technologies among SMEs. In Nigeria, where fewer SMEs exist today than in the 1960s and where only about a quarter rely on technology (Nakpodia et al., 2024), a collaborative network is being created to share experiences of AI implementation and stimulate interest in new technologies. This interplay highlights the applicability of the DOI lens to understand social phenomena driving or hindering AI adoption in resource-poor settings.

Integrating Dynamic Capabilities and Institutional Perspectives

While the Resource-Based View and Diffusion of Innovations frameworks provide a strong foundation for understanding AI adoption among African SMEs, the findings of this review also align with complementary theoretical perspectives that deepen explanatory power. Dynamic Capabilities theory offers valuable insight into how SMEs continuously adapt, reconfigure, and renew their resource bases in response to volatile and uncertain environments (Teece, Pisano & Shuen, 1997). From this perspective, AI adoption is not a one-off technological decision, but an ongoing process of learning, experimentation, and capability development shaped by environmental turbulence. Dynamic Capabilities theory helps explain why African SMEs often adopt AI incrementally, using basic tools such as chatbots and predictive analytics before scaling more advanced applications. These iterative processes enable firms to sense emerging opportunities, seize technological benefits, and transform operational routines despite persistent resource constraints. This lens complements the RBV by shifting attention from static resource possession to adaptive capability building over time.

Institutional Theory further enriches the analysis by illuminating how regulatory ambiguity, governance quality, and policy coherence shape AI diffusion across African contexts (Kedi et al., 2024). Weak enforcement mechanisms, fragmented digital policies, and inconsistent data governance frameworks increase uncertainty and influence both the pace and direction of AI adoption. Together, RBV, DOI, Dynamic Capabilities, and Institutional Theory provide a more holistic framework for understanding how African SMEs navigate technological innovation within structurally constrained and institutionally complex environments.

Research Gaps and Unresolved Challenges

Despite the growing body of literature on digital transformation and Artificial Intelligence in SMEs, several critical gaps remain insufficiently addressed. At the theoretical level, existing frameworks inadequately explain how SMEs innovate when strategic resources are scarce, institutional environments are unstable, and technological adoption is driven by survival rather than long-term planning. The dominant reliance on RBV and technology adoption models often overlooks the adaptive and improvisational nature of innovation in volatile contexts. At the empirical level, research on AI adoption in African SMEs remains fragmented, sector-specific, and largely descriptive. There is limited synthesis of how AI contributes to resilience and competitiveness across different industries and institutional settings, and few studies systematically examine patterns of consensus and divergence within the literature. This limits cumulative knowledge building and weakens theory development. From a practical perspective, unresolved challenges persist regarding digital skills development, ethical AI use, data governance, and inclusive access to AI technologies, particularly for rural, informal, and female-led enterprises. While these challenges are frequently mentioned, they are rarely articulated as interconnected problems requiring coordinated ecosystem and policy responses. This study responds to these unresolved issues by systematically mapping existing evidence and identifying areas where theory and practice remain underdeveloped.

THEORETICAL BACKGROUND AND RESEARCH GAPS

Research on Artificial Intelligence adoption in small and medium-sized enterprises has grown rapidly over the past decade, particularly within the broader digital transformation and innovation literature. Globally, AI adoption in SMEs is commonly theorised through firm-level capability perspectives, technology adoption models, and innovation diffusion frameworks, with a strong emphasis on strategic intent, data availability, and technological readiness (Rambe & Masupa, 2025). Much of this literature, however, is rooted in developed economy contexts characterised by relatively stable institutional environments, mature digital infrastructure, and access to specialised skills. The Resource-Based View (RBV) has been widely applied to explain how digital technologies, including AI, function as strategic resources that enable firms to achieve competitive advantage through efficiency gains, knowledge creation, and improved decision-making (Barney, 1991). Within this tradition, AI is often conceptualised as a valuable, rare, and inimitable resource when combined with complementary organisational capabilities. However, RBV-based studies tend to assume that firms possess a minimum threshold of financial, technological, and human resources, an assumption that does not hold for many SMEs operating in resource-constrained and volatile environments. As a result, RBV provides limited explanatory power for understanding how firms innovate when critical resources are absent or unevenly distributed.

The Diffusion of Innovations (DOI) theory has also been extensively used to explain technology adoption in SMEs by focusing on perceptions of relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). While DOI is useful for understanding adoption decisions at the organisational and social-system level, it offers less insight into how sustained adoption unfolds under conditions of institutional instability, policy ambiguity, and infrastructural fragility. In African SME contexts, adoption decisions are often shaped not only by perceived technological benefits but also by survival pressures, informal business practices, and external ecosystem support, dimensions that remain underexplored in mainstream DOI applications. More recently, scholars have called for greater attention to innovation under constraint, particularly in emerging economies where firms adopt digital technologies incrementally and pragmatically rather than through large-scale transformation initiatives (George et al., 2016). Despite this growing recognition, the literature lacks a coherent theoretical explanation of how AI adoption unfolds in volatile, uncertain, complex, and ambiguous environments, especially within African SME ecosystems. Existing studies tend to describe outcomes such as improved efficiency or resilience without clearly theorising the underlying mechanisms that connect resource scarcity, institutional context, and innovation trajectories.

From a practical standpoint, significant challenges also remain unresolved. While policy reports and empirical studies frequently highlight barriers such as skills shortages, high costs, and weak infrastructure, there is limited synthesis of how these constraints interact with firm-level capabilities and external support systems to shape AI adoption outcomes over time. Furthermore, the role of intermediary actors such as universities, non-governmental organisations, and innovation hubs is often acknowledged but insufficiently theorised within existing SME and innovation frameworks. Against this background, this study addresses three interrelated gaps. First, there is a theoretical gap concerning how AI adoption can be explained in SMEs operating under persistent resource constraints and institutional volatility. Second, there is a methodological gap in synthesising fragmented empirical evidence on AI adoption in African SMEs using systematic and reproducible review techniques. Third, there is a practical gap in identifying unresolved challenges and policy-relevant problems that continue to hinder inclusive and sustainable AI diffusion in African SME ecosystems. By addressing these gaps, the study aims to strengthen the theoretical grounding of AI research in emerging economies while offering clearer insights for scholars, practitioners, and policymakers.

METHODOLOGY

Research Design

This study employs a Systematic Literature Review (SLR) integrated with bibliometric analysis to explore the intersection of Artificial Intelligence (AI), Small and Medium Enterprises (SMEs), and VUCA dynamics in African contexts. The SLR offers a rigorous and transparent way to gather and synthesise peer-reviewed research across multiple disciplines, ensuring that the findings are grounded in high-quality sources. This is especially useful in examining complex and emerging topics where studies are fragmented or still evolving. The bibliometric analysis complements the SLR by providing a quantitative lens to examine trends, publication patterns, and intellectual structures. Tools such as Bibliometrix (R) and VOSviewer were chosen to map keyword co-occurrence, track influential publications, and visualise author networks. These insights help to identify gaps and emerging focus areas in the literature. This dual approach is well-suited to the African context, where SMEs often operate in resource-constrained environments shaped by volatility and uncertainty. It allows for a more holistic understanding of how AI can enhance adaptability, innovation, and sustainability within these firms. The integration of both methods ensures a comprehensive and balanced view that informs policy, practice, and future research.

Data Sources and Search Strategy

This study utilised *Scopus* and *Web of Science* as the primary databases for data collection. These platforms were selected due to their broad indexing of peer-reviewed, high-quality research across disciplines relevant to Artificial Intelligence (AI), Small and Medium Enterprises (SMEs), and the VUCA context in Africa.

The literature search was guided by a Boolean search strategy designed to capture studies at the intersection of artificial intelligence, small and medium-sized enterprises (SMEs), the African context, and VUCA conditions. Synonymous terms were combined using the Boolean operator *OR*, while the four core concepts were linked using *AND*. The search string was formulated as follows:
("Artificial Intelligence" OR AI OR "Generative Artificial Intelligence" OR "Machine Learning") AND ("Small and Medium Enterprises" OR SMEs OR "Small Business" OR "Medium Enterprise") AND (Africa OR "Sub-Saharan Africa" OR "Developing Countries") AND (VUCA OR Volatility OR Uncertainty OR Complexity OR Ambiguity).

Inclusion and Exclusion Criteria

To ensure the relevance and rigour of the review, clearly defined inclusion and exclusion criteria were applied throughout the screening process. The review focused on peer-reviewed journal articles published between 2000 and 2025, written in English. Only studies that directly addressed the use or impact of Artificial Intelligence (AI) within the context of Small and Medium Enterprises (SMEs) in Africa were considered. Additionally, papers needed to engage with themes related to VUCA (volatility, uncertainty, complexity and ambiguity), particularly as they affect SME operations in dynamic and resource-constrained environments. The review excluded all grey literature, including conference proceedings, book chapters, editorials, and theses. Studies that centred solely on large firms or lacked clear geographic relevance to Africa were also omitted. Furthermore, papers that discussed digital technologies broadly but did not explicitly refer to AI, or those that mentioned SMEs without providing sector-specific insights, were not considered. A total of 728 documents were initially retrieved from the combined database searches. After removing duplicates and screening titles and abstracts for relevance, 214 articles were assessed in full. Following the application of the inclusion and exclusion criteria, 95 studies met all requirements and were included in the final synthesis.

Screening and Selection Process

The screening and selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure transparency and reproducibility. The process began with the identification of a total of 728 records through structured searches in Scopus and Web of Science. After removing 132 duplicate entries, 596 unique articles remained for initial screening. During the screening phase, titles and abstracts were reviewed for relevance. At this stage, 382 articles were excluded as they did not meet the basic inclusion criteria, often due to a lack of focus on AI, SMEs, or the African context. This left 214 full-text articles assessed for eligibility. In the eligibility stage, the full texts were carefully examined to confirm alignment with the research scope, geographical focus, and methodological rigour. A further 119 articles were excluded, largely due to insufficient relevance to AI in African SMEs or failure to engage with VUCA-related challenges. Ultimately, 95 studies were included in the final synthesis. These articles formed the basis for both the bibliometric analysis and the thematic interpretation. A PRISMA flow diagram summarising this process is provided below for visual reference.

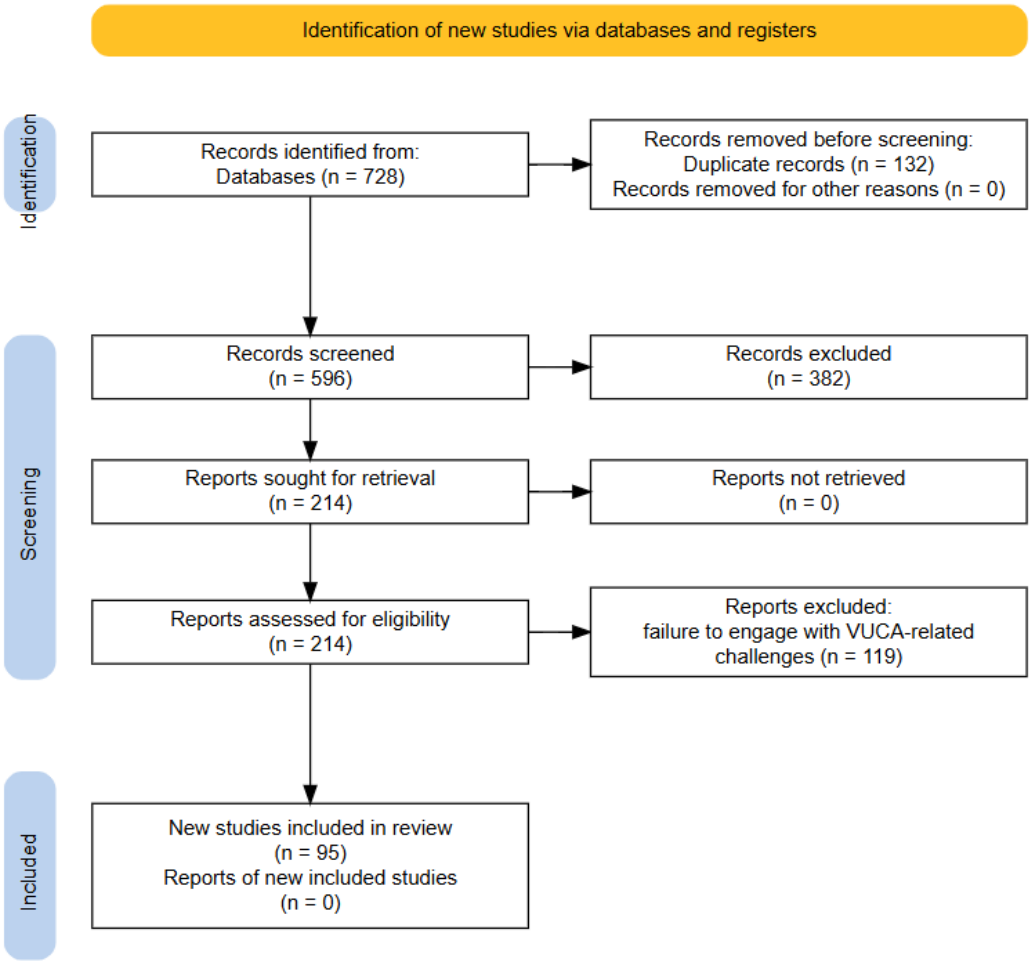

Figure 1. PRISMA Flow Diagram

Bibliometric Analysis Procedure

To complement the systematic review, a bibliometric analysis was conducted using two specialised tools: Bibliometrix (an R-based package) and VOSviewer. Bibliometrix was employed to extract and manage bibliographic data, enabling the generation of descriptive statistics such as annual publication trends, most prolific authors, and top publishing journals. This provided a high-level overview of how scholarly interest in the intersection of Artificial Intelligence, SMEs, and VUCA within Africa has evolved over time. VOSviewer was used to create visual maps of the intellectual structure of the literature. It allowed for the identification of keyword co-occurrence patterns, which revealed dominant research topics and thematic clusters. The software was also used to explore authorship networks, showing collaboration patterns among scholars, as well as citation and co-citation analyses to highlight the most influential contributions and knowledge bases in the field. Together, these tools offered a deeper understanding of how the literature is organised, where research activity is concentrated, and which areas remain underexplored. The combined use of quantitative and visual outputs supported the thematic synthesis and provided a strong foundation for interpreting emerging trends. Bibliometric analyses were conducted using Biblioshiny, the web-based interface of the Bibliometrix R package, which enables performance analysis and science mapping of large bibliographic datasets (Aria & Cuccurullo, 2017). Network visualisations of keywords and author collaboration were generated using VOSviewer, a software tool designed for constructing and visualising bibliometric networks (van Eck & Waltman, 2010).

Thematic Synthesis Approach

Following the bibliometric analysis, a qualitative thematic synthesis was conducted to extract deeper insights from the 95 included studies. Each article was read in full and systematically coded using a manual, inductive approach. This process involved identifying recurring concepts, practices, and challenges related to the adoption of Artificial Intelligence in African SMEs, particularly in relation to VUCA dynamics. Initial codes were assigned based on key themes emerging from the literature, such as digital capability development, innovation under constraint, resilience strategies, and policy or infrastructural enablers. These codes were then iteratively refined as more studies were reviewed, allowing for the development of broader patterned categories. Articles were grouped according to these recurring insights, which were then interpreted to construct a narrative around the most prominent focus areas. This thematic synthesis enabled the study to move beyond citation metrics and engage with the substance of the literature, drawing attention to the strategic and operational responses of SMEs to environmental volatility, and the varied ways in which AI is being integrated across sectors and contexts. It also helped identify conceptual gaps and underrepresented perspectives, particularly those relating to informal economies, gendered experiences, and scalability challenges in resource-constrained settings.

The thematic synthesis followed a structured and transparent coding protocol to enhance rigour and reproducibility. An inductive coding approach was employed in the initial phase, allowing themes to emerge directly from the data rather than being imposed a priori. This was followed by a second-cycle analytical coding process, during which related codes were grouped into higher-order categories reflecting patterns of AI adoption, resource constraints, and adaptive strategies. To ensure the quality of the included studies, each article was assessed against predefined criteria focusing on methodological clarity, relevance to African SME contexts, and explicit engagement with Artificial Intelligence. Studies that lacked sufficient empirical grounding or provided only superficial discussion of AI were retained for descriptive purposes but given lower analytical weight during synthesis. Theme validation was achieved through iterative comparison across studies and cross-checking against bibliometric clusters, ensuring consistency between quantitative patterns and qualitative interpretations.

RESULTS

This section presents the findings from both the bibliometric and thematic analyses of the 95 selected studies. The results are organised to provide a structured understanding of how Artificial Intelligence is being discussed and applied within the context of African Small and Medium Enterprises (SMEs) facing VUCA (Volatile, Uncertain, Complex, and Ambiguous) conditions. The first part outlines descriptive bibliometric trends, including publication outputs, leading contributors, and citation patterns. This is followed by an exploration of keyword networks and conceptual groupings that emerged through co-occurrence mapping. The final part synthesises key themes from the literature, highlighting how AI is being positioned to support SME resilience, innovation, and adaptability in dynamic and resource-constrained environments. Together, these findings offer a comprehensive picture of the academic landscape, its key conversations, and the directions in which research in this field is evolving.

Descriptive Bibliometric Findings

The bibliometric analysis of the 95 included studies reveals important insights into the evolution, structure, and geographical distribution of research on Artificial Intelligence (AI) in African SMEs within volatile and resource-constrained environments.

Annual Publication Trends:

Figure 2 summarises the main information on the dataset, while Figure 3 illustrates the annual scientific production from 2000 to 2025. The trajectory shows a gradual increase in scholarly interest from 2000, with a marked surge from 2018 onwards. This growth aligns with the increasing relevance of digital transformation in African economies and the acceleration of AI adoption following the COVID-19 pandemic. The year 2023 recorded the highest number of publications, suggesting heightened academic engagement with AI-driven solutions for SMEs facing VUCA conditions.

Top Contributing Journals, Authors, and Countries:

The analysis of sources (Figure 3) highlights that the most productive journals in this domain include Cogent Business & Management, Human Resources for Health, and Benchmarking: An International Journal, which together account for a significant proportion of the total output. These journals reflect a cross-disciplinary engagement spanning business innovation, health systems, and performance evaluation. Figure 4 displays authorship trends, identifying a small but growing group of scholars consistently contributing to this field. While no single author dominates, emerging networks of collaboration indicate a diffusion of interest across various African research institutions.

In terms of geographical distribution, Figure 5 shows that the majority of publications originate from South Africa, Nigeria, and Kenya. These countries lead both in single-country publications (SCP) and multi-country publications (MCP), indicating a strong domestic research base as well as increasing cross-border collaboration. Notably, international collaborations are more frequent among studies originating in North and East Africa, with European co-authors contributing to discussions on AI policy and digital infrastructure.

Citation Metrics and Collaboration Patterns:

The citation analysis reveals a total of 2,458 citations across the 95 articles, with an average of 25.9 citations per article and a combined h-index of 29. This suggests a relatively high level of influence and

scholarly engagement within the selected works. The most cited articles focus on frameworks for AI adoption, digital resilience strategies, and innovation ecosystems in Africa. Collaboration patterns are visualised in the three-field plot (Figure 6), which links authors, affiliations, and countries. The figure reveals a notable concentration of institutional affiliations in South African and Nigerian universities, as well as increasing involvement from international agencies and NGOs. Although the field is still fragmented, several regional hubs of expertise are emerging, signalling a maturing research landscape.

Figure 2. Main information, generated using Biblioshiny (Aria & Cuccurullo, 2017)

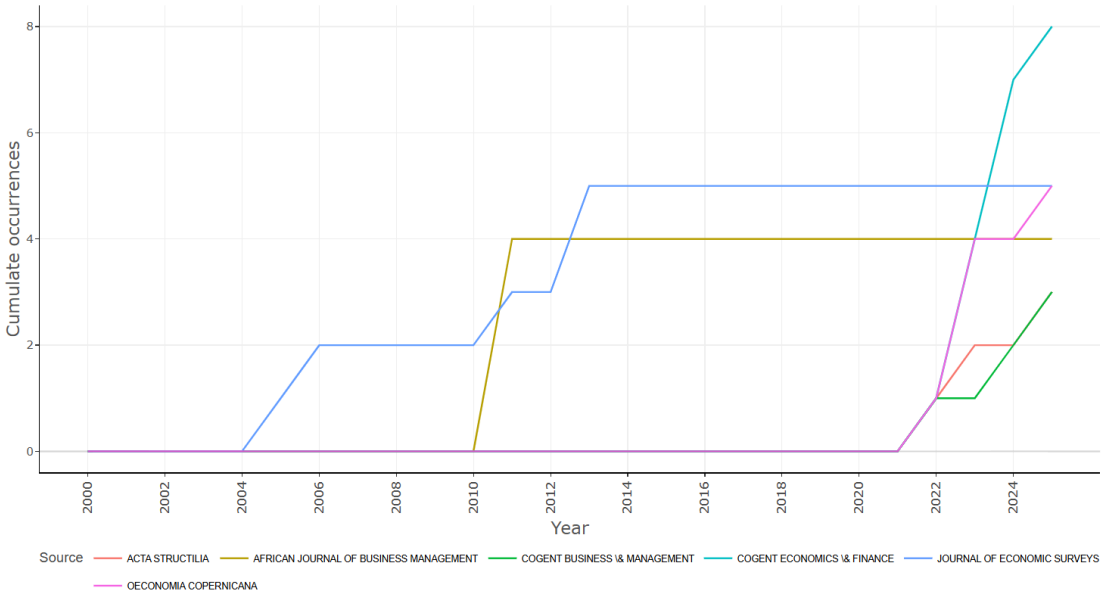

Figure 3. Sources production overtime, generated using Biblioshiny (Aria & Cuccurullo, 2017)

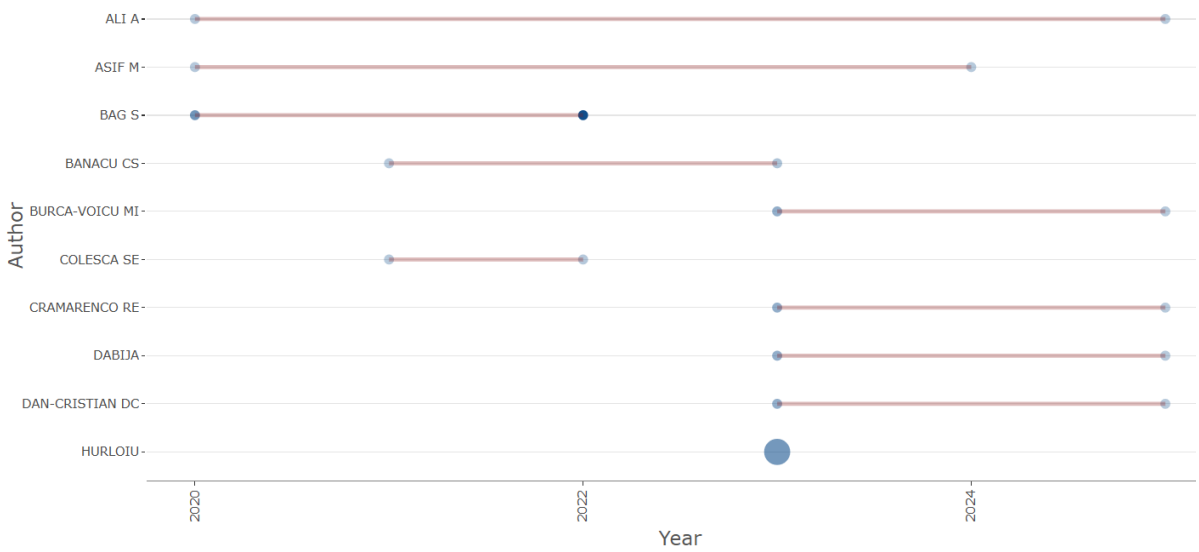

Figure 4. Authors production overtime, generated using Biblioshiny (Aria & Cuccurullo, 2017)

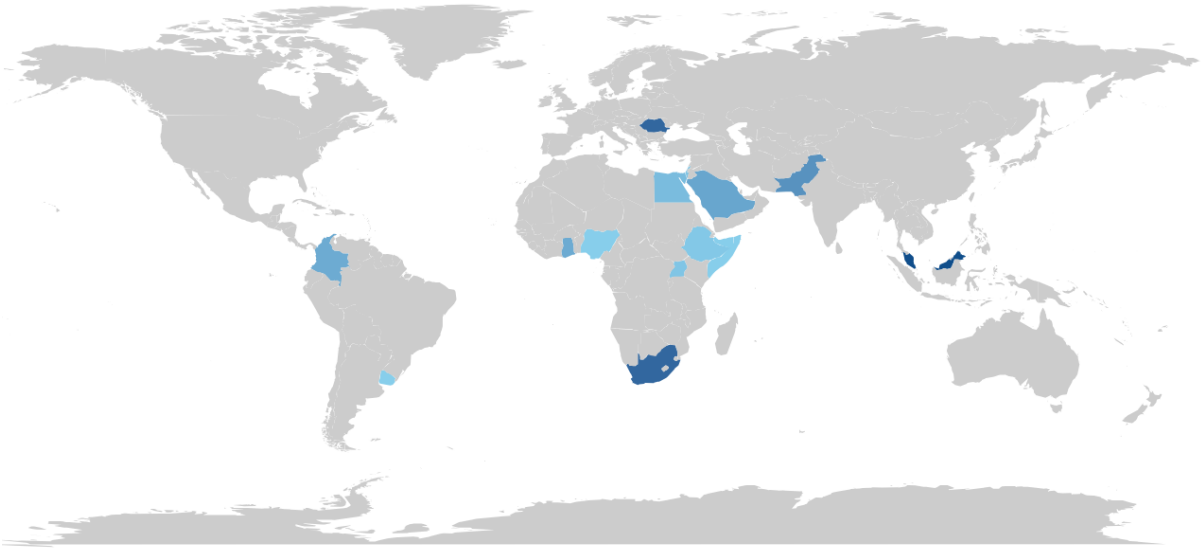

Figure 5. Countries Scientific Production, generated using Biblioshiny (Aria & Cuccurullo, 2017)

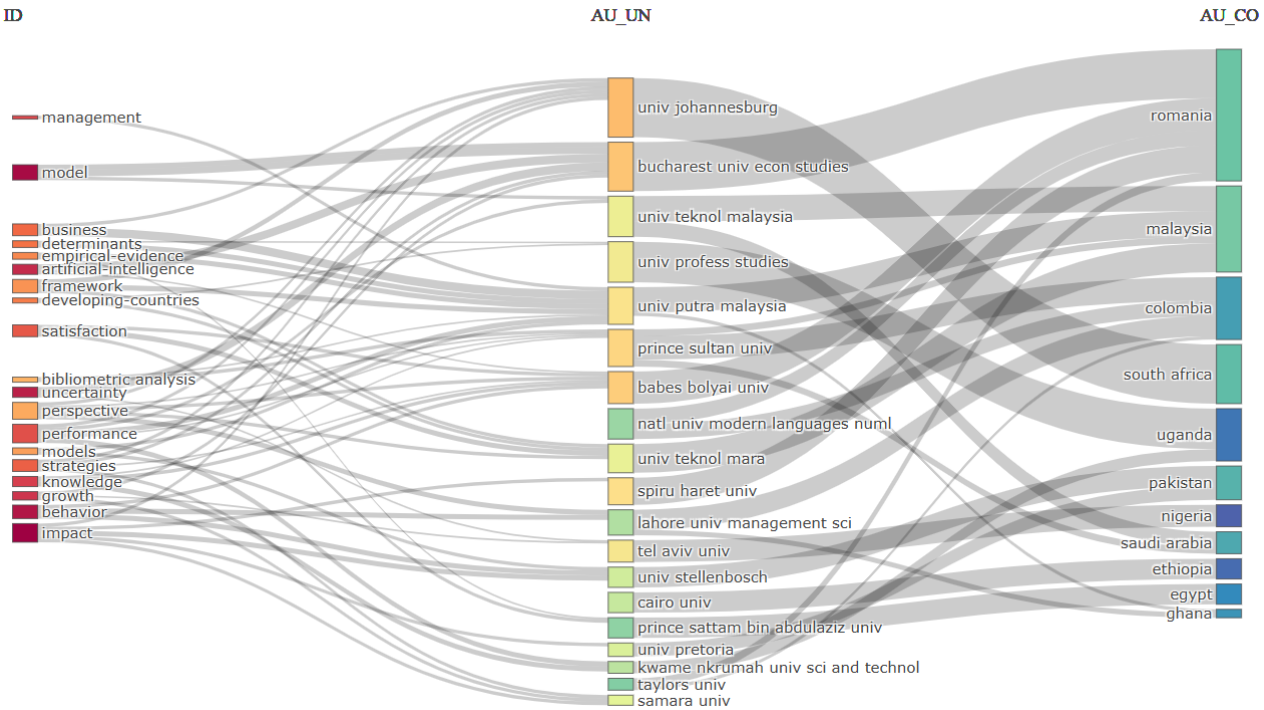

Figure 6. Three-field plot, generated using Biblioshiny (Aria & Cuccurullo, 2017)

Keyword Analysis and Thematic Mapping

To uncover the intellectual structure of the literature and identify dominant conceptual areas, a comprehensive keyword co-occurrence analysis was conducted using author keywords and indexed terms from the 95 selected studies. This analysis provides insight into how scholars are framing the intersection of AI, SMEs, and the VUCA landscape in Africa.

Most Frequent Keywords and Co-Occurrence Patterns:

Figures 7 to 9 display keyword co-occurrence networks generated at three different thresholds (21, 120, and 779), reflecting varying levels of specificity. At the lower threshold (Figure 7), a broad spectrum of keywords appears, including terms such as artificial intelligence, SMEs, Africa, innovation, and digital transformation. As the threshold increases (Figures 8 and 9), the network becomes more focused, highlighting core recurring concepts with stronger co-occurrence relationships.

The most frequently used keywords include artificial intelligence, small and medium enterprises, digitalisation, resilience, technology adoption, and VUCA. Their central placement and numerous links in the network maps suggest they are foundational to the discourse. Keywords such as sustainability, data analytics, governance, and policy frameworks also feature prominently, reflecting the multidisciplinary nature of the field.

Figure 10 provides a word cloud that visually emphasises the frequency of specific terms, reinforcing the centrality of AI, SMEs, resilience, and infrastructure in the literature. The prominence of gender, healthcare, and agribusiness as emerging keywords also points to growing sectoral interest and contextual diversification within the research.

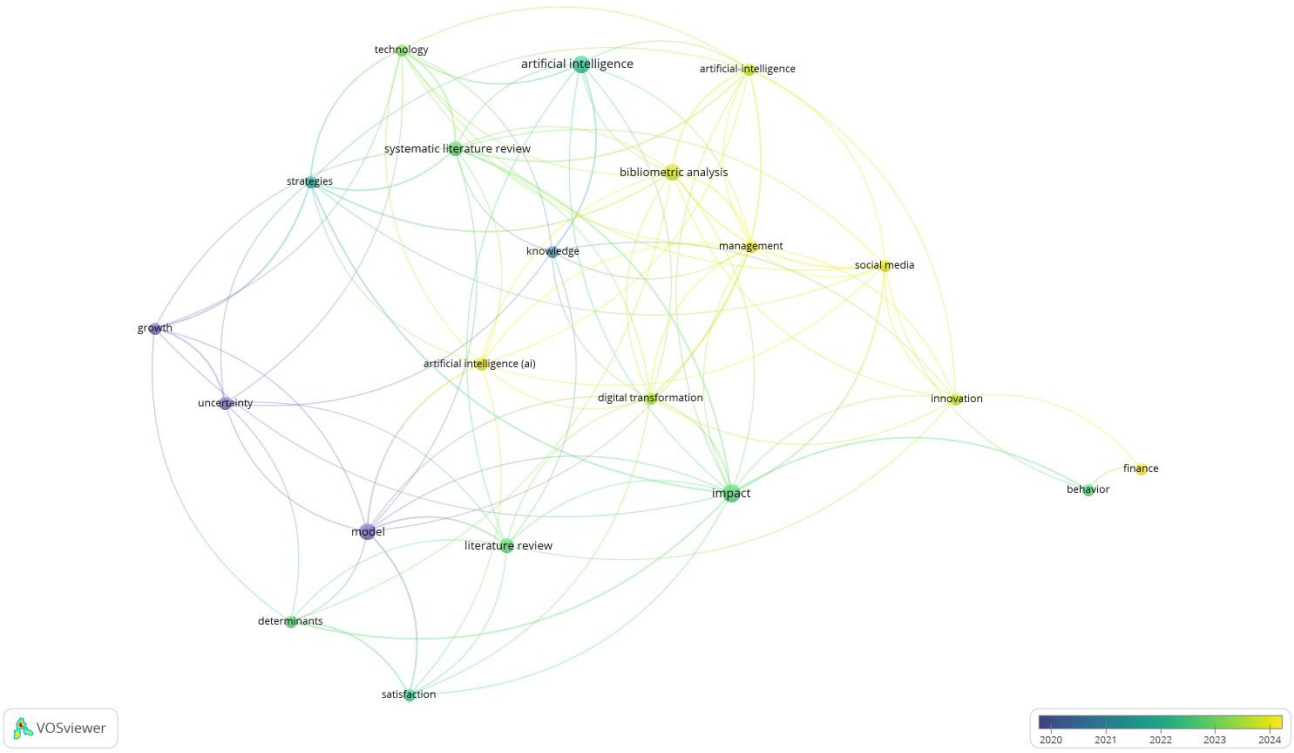

Figure 7. Keywords occurrence (21 threshold), generated using VOSviewer (van Eck & Waltman, 2010)

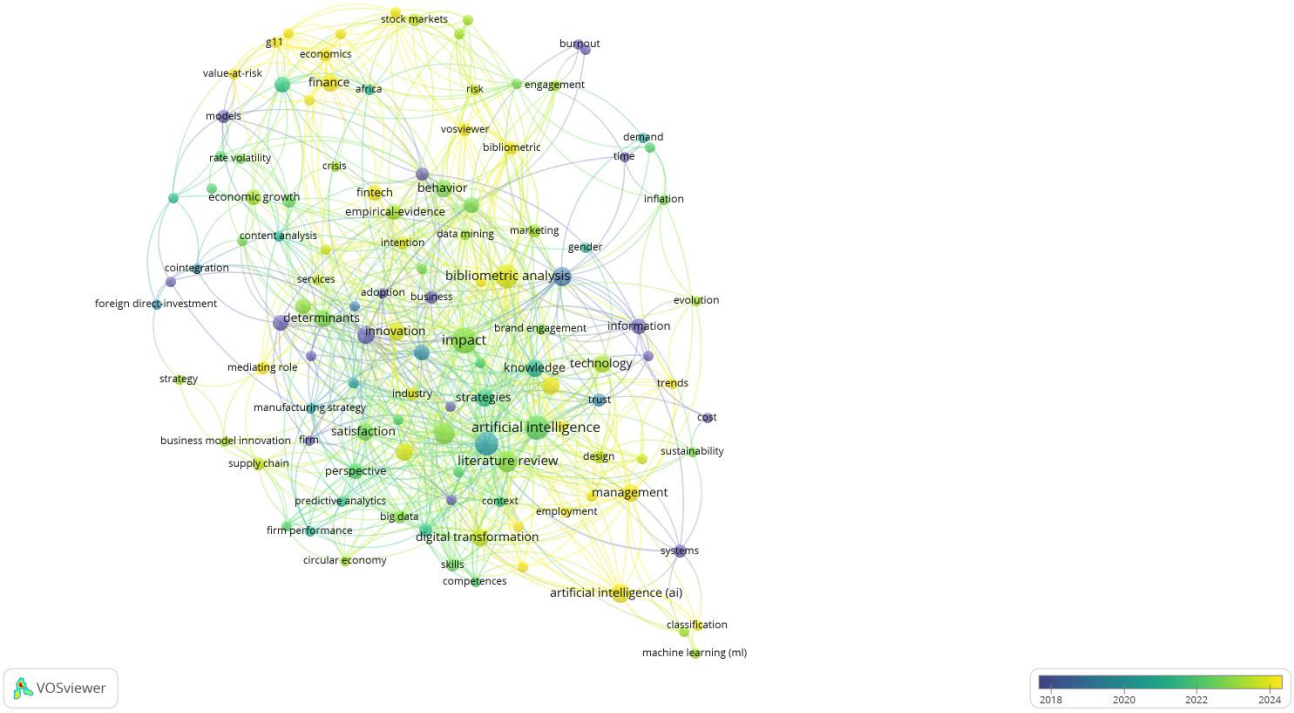

Figure 8. Keywords occurrence (120 threshold), generated using VOSviewer (van Eck & Waltman, 2010)

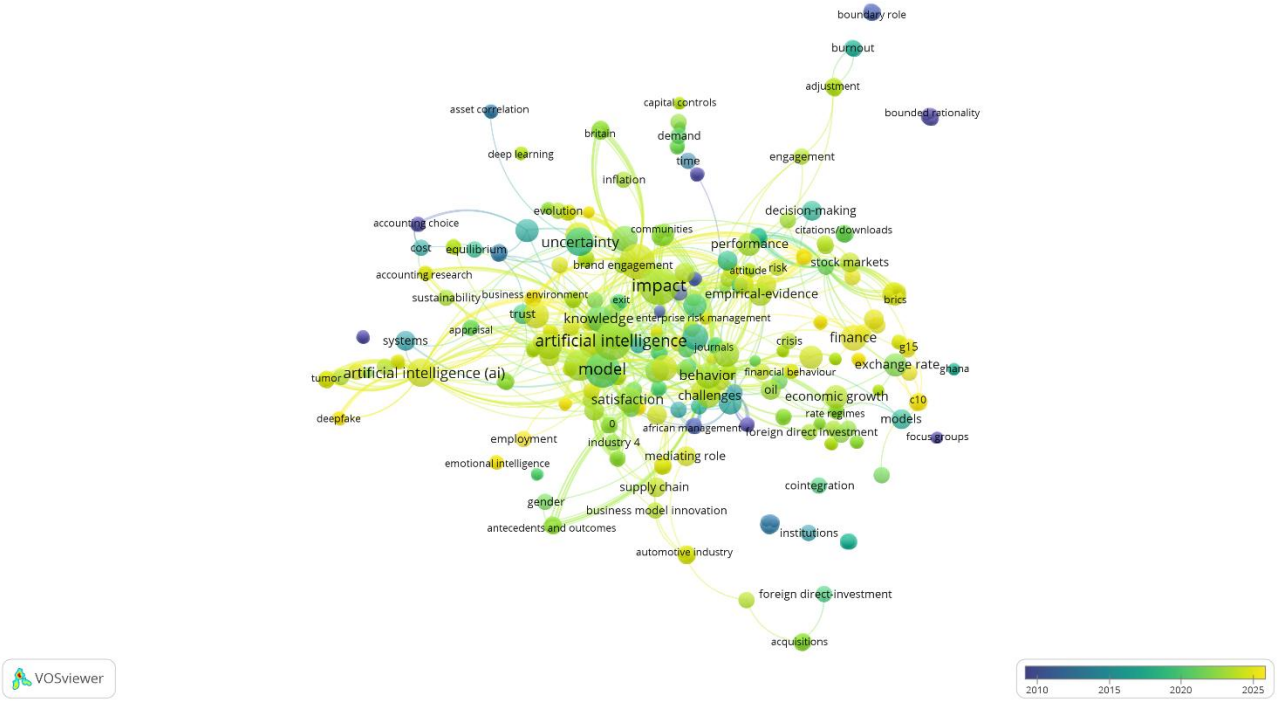

Figure 9. Keywords occurrence (779 threshold), generated using VOSviewer (van Eck & Waltman, 2010)

Figure 10. Word cloud, generated using Biblioshiny (Aria & Cuccurullo, 2017)

Thematic Synthesis of Relevant Literature

This section presents a thematic synthesis of the 95 reviewed studies to capture core insights into how AI is applied within African SMEs facing VUCA conditions. The analysis is organised around key

focus areas that emerged across the literature, highlighting shared challenges, strategic responses, and contextual nuances.

AI Capability Development and Digital Transformation

SMEs adopted AI primarily for automation, customer engagement, and data-driven decision-making in response to operational uncertainty (Ebuka, Emmanuel & Idigo, 2023). Digital capability development was closely associated with external technical support, particularly from incubators and NGO-led training initiatives (Tchamyou, Somé & Asongu, 2025). Most firms deployed low-cost, mobile-based AI tools such as chatbots and basic analytics, reflecting infrastructural and financial constraints (Olayemi, Grace & Tunji, 2022). Adoption was often sector-specific, with health, agriculture, and retail showing the most consistent application of AI technologies (Sarfo, Fakhar Manesh & Caputo, 2025). Urban-based SMEs demonstrated higher uptake compared to rural counterparts, primarily due to disparities in digital infrastructure (Morozova et al., 2023). Internal skill development emerged as both a prerequisite and consequence of AI use, particularly in firms with prior exposure to digital transformation (Khoza & Mkosana, 2025). University and innovation hub collaborations were reported as effective enablers of digital capacity among SMEs, especially where public–private partnerships were established (Simba et al., 2025).

Resilience and Adaptation in VUCA Contexts

SMEs employed a range of adaptive strategies to mitigate the effects of volatility, uncertainty, complexity, and ambiguity, with resilience consistently framed as both a strategic orientation and operational outcome (Nakpodia et al., 2024). Agility in decision-making, enabled by AI-driven forecasting tools and scenario modelling, was frequently adopted to improve responsiveness to market shocks (Kwenda & Harrison, 2025). Many firms shifted to digital service delivery models and e-commerce platforms as a direct response to COVID-19 disruptions, particularly in retail and education sectors (Musyoka & Ouma, 2024). The role of AI in supporting crisis response was especially visible in health-focused SMEs, where predictive analytics and chatbot interfaces were deployed for patient triage and information dissemination (Nguimkeu & Okou, 2021). Case studies revealed that resilience was often externally supported through donor-funded programmes and ecosystem partnerships, highlighting the importance of inter-organisational networks in sustaining SME operations under pressure (Simba et al., 2025). However, adaptive capacity was uneven, with limited uptake among informal and rural enterprises due to infrastructural and skills-related constraints (Mvula, 2024).

Governance, Policy, and Institutional Support

Studies consistently emphasised that the pace and direction of AI adoption among African SMEs are significantly shaped by national digital strategies, regulatory clarity, and the availability of enabling infrastructure (Kosgei & Agwata, 2021). Weak regulatory enforcement, fragmented ICT policies, and poor inter-agency coordination were frequently cited as barriers to scaling AI solutions, particularly in countries with inconsistent digital governance structures (Nakpodia et al., 2024). Public-private partnerships were reported as effective in promoting AI adoption, particularly where government incentives supported SME participation in digital innovation ecosystems (Simba et al., 2025). Initiatives such as AI incubation hubs, data-sharing platforms, and SME-targeted grants were highlighted as institutional mechanisms that reduced entry barriers and improved innovation readiness (Sarfo, Fakhar Manesh & Caputo, 2025). Cross-border regulatory inconsistencies in data protection and intellectual property rights created uncertainty for AI-integrated SMEs operating in regional markets, particularly within the Southern African Development Community (SADC) and Economic Community of West African States (ECOWAS) blocs (Morozova et al., 2023). Furthermore, poor investment in foundational infrastructure such as electricity, broadband, and digital identity systems remained a key constraint, particularly for rural and informal enterprises (Mvula,

2024). Where national digital policies aligned with inclusive economic strategies, SMEs demonstrated stronger levels of AI experimentation and uptake, particularly in health, education, and agriculture sectors (Tchamyou, Somé & Asongu, 2025). However, policy documents often lacked clear implementation plans or measurable targets, weakening their potential impact on SME digital transformation (Kwenda & Harrison, 2025).

Sector-Specific and Gendered Perspectives

AI adoption within agribusiness SMEs focused on the use of predictive analytics, drone monitoring, and weather-informed decision systems to improve yield forecasting and market access. These tools were most effective in youth-run cooperatives and export-driven value chains (Sarfo, Fakhar Manesh & Caputo, 2025). In the health sector, AI-supported triage systems, chatbots, and remote diagnostic tools were deployed to address service delivery gaps in rural areas. These tools proved critical during the COVID-19 pandemic, enabling decentralised healthcare access and reducing reliance on limited human resources (Nguimkeu & Okou, 2021). Educational SMEs leveraged AI through adaptive learning platforms and mobile-based tutoring services. Such tools were particularly effective in mitigating the digital divide among learners in underserved regions, especially where national ICT policies supported blended learning initiatives (Kosgei & Agwata, 2021). Gendered insights revealed that female-led SMEs faced systemic barriers in accessing and applying AI technologies. Challenges included limited exposure to digital training, financial constraints, and restrictive socio-cultural norms. However, women-focused incubators and targeted digital literacy programmes showed promise in bridging these divides when linked to local support networks (Tchamyou, Somé & Asongu, 2025). Context-specific interventions, especially those grounded in community needs and delivered through trusted institutions, were more likely to result in sustainable AI uptake. This was evident in sectors where public service gaps were acute, and where AI offered clear functional value (Nakpodia et al., 2024).

Bibliometric Insights on Consensus and Remaining Gaps

The bibliometric analysis reveals several areas of convergence within the literature. There is strong consensus around the role of AI in enhancing operational efficiency, supporting decision-making, and improving resilience among SMEs operating in uncertain environments. Keywords related to digital transformation, innovation, and resilience dominate co-occurrence networks, indicating shared recognition of AI's strategic relevance. However, the analysis also exposes notable gaps. Ethical considerations, including data privacy, algorithmic bias, and workforce implications, remain weakly connected to core AI adoption clusters. Similarly, limited attention is given to informal enterprises, longitudinal adoption processes, and theory-driven explanations of innovation under constraint. The fragmentation of theoretical perspectives across clusters further suggests that AI research in African SMEs has yet to coalesce around an integrated explanatory framework. These gaps highlight the need for deeper theoretical engagement and more context-sensitive models of digital transformation.

DISCUSSION

The review reveals that Artificial Intelligence (AI) in African SMEs is primarily conceptualised as a pragmatic tool for addressing operational inefficiencies, mitigating uncertainty, and responding to complex and often volatile market environments. AI is not viewed in abstract or futuristic terms but rather as a set of accessible technologies such as chatbots, predictive analytics, and automation tools applied to improve real-time decision-making, streamline operations, and extend service delivery in resource-constrained settings (Ebuka, Emmanuel & Idigo, 2023). This practical orientation reflects the necessity-driven innovation landscape many African SMEs operate within, where digital solutions are often adopted out of survival rather than strategy.

AI's contribution to resilience, adaptability, and innovation is most evident in how SMEs leverage these tools to respond to environmental shocks and systemic vulnerabilities. AI-driven forecasting, e-commerce platforms, and digital service delivery models were widely adopted during and after the COVID-19 pandemic, particularly in health, education, and retail sectors (Musyoka & Ouma, 2024). These technologies enabled SMEs to maintain operations, pivot offerings, and serve hard-to-reach populations, especially where traditional infrastructure and public services were lacking. In this way, AI supports not only firm-level resilience but also contributes to broader social objectives aligned with the SDGs, including health (SDG 3), education (SDG 4), decent work and economic growth (SDG 8), and industry innovation (SDG 9).

The findings also show that institutional factors such as governance quality, digital infrastructure, and policy coherence either enable or constrain AI diffusion. SMEs operating in urban or well-connected environments benefit from more consistent regulatory support and technical resources, while rural and informal enterprises remain digitally excluded (Morozova et al., 2023). Despite the growing presence of national digital strategies, weak implementation frameworks and inconsistent cross-border regulations continue to limit the scalability of AI solutions (Nakpodia et al., 2024). These institutional gaps are particularly relevant to understanding how SMEs navigate ambiguity and complexity, two defining elements of the VUCA landscape. From a knowledge standpoint, this review highlights the critical role of context in shaping AI innovation. Gendered and sector-specific insights show that equitable access to AI technologies is far from guaranteed. Female-led enterprises often lack exposure to digital skills and financing opportunities, necessitating targeted support through incubators, training hubs, and blended learning models (Tchamyou, Somé & Asongu, 2025). Furthermore, SMEs in sectors such as agribusiness and healthcare demonstrate how AI can offer sector-sensitive solutions that not only improve efficiency but also address systemic developmental gaps (Sarfo, Fakhar Manesh & Caputo, 2025). These findings add to the growing body of African-centred digital entrepreneurship literature by illustrating how AI is adapted, rather than simply adopted, to meet local needs under volatile conditions. Overall, the studies reflect a growing awareness of AI as a resilience-enhancing and capability-building asset. Yet, this potential remains unevenly realised due to persistent structural inequalities, limited internal digital capacity, and the absence of coordinated policy mechanisms. By bringing attention to these dynamics, this review contributes new empirical insights into how AI can serve as a lever for sustainable development in African SME ecosystems, particularly when innovation is situated within broader institutional and societal frameworks.

Interpreting AI Adoption under Resource Constraints through RBV and DOI

Interpreting the findings through the Resource-Based View highlights the tension between strategic intent and resource availability in African SMEs. While AI technologies offer potential competitive advantages, their value is contingent on complementary resources such as digital skills, data quality, and organisational routines. In resource-constrained environments, SMEs rarely possess these resources simultaneously, leading to selective and incremental AI adoption rather than comprehensive transformation (Barney, 1991). From a Diffusion of Innovations perspective, the findings suggest that AI adoption is primarily driven by perceived relative advantage and compatibility with existing practices, while complexity and cost act as significant deterrents. SMEs favour AI tools that integrate seamlessly into mobile-based operations and require minimal technical expertise, explaining the prevalence of chatbots and basic analytics. This pattern illustrates how resource constraints shape innovation trajectories, reinforcing the argument that adoption decisions are socially and institutionally embedded rather than purely rational or technology-driven (Rogers, 2003).

Ethical and Social Considerations in AI Adoption

Beyond operational and strategic considerations, the diffusion of Artificial Intelligence among African SMEs raises important ethical and social implications that warrant closer attention. One key concern relates to data privacy and governance, particularly in contexts where regulatory frameworks for data protection remain underdeveloped or inconsistently enforced. SMEs frequently rely on third-party platforms and cloud-based AI tools, increasing exposure to data misuse and cross-border data vulnerabilities. Algorithmic bias also presents a growing risk, especially where AI systems are trained on datasets that inadequately reflect local socio-economic realities. Such biases may reinforce existing inequalities, particularly in credit assessment, recruitment, and customer segmentation processes (Ebuka, Emmanuel & Idigo, 2023). For resource-constrained SMEs with limited technical oversight, identifying and mitigating these risks remains a significant challenge. Additionally, concerns around employment displacement and job reconfiguration emerge as AI automates routine tasks. While AI can enhance productivity and reduce costs, it may also disproportionately affect low-skilled workers if reskilling initiatives are not integrated into adoption strategies. These ethical considerations highlight the need for responsible and inclusive AI governance models that balance efficiency gains with social sustainability. Addressing these issues strengthens the alignment between AI adoption and broader development objectives within African SME ecosystems.

Positioning African SME AI Adoption within International Business Scholarship

While this review is grounded in African SME contexts, its findings also speak directly to broader international business and global digital transformation debates. In contrast to SMEs in developed economies, where AI adoption is often driven by strategic investment, advanced data infrastructures, and specialised digital talent, African SMEs typically engage with AI through low-cost, modular, and mobile-enabled solutions that address immediate operational constraints (Ebuka, Emmanuel & Idigo, 2023). This divergence highlights how institutional stability, regulatory predictability, and resource abundance shape distinct technological adoption pathways across regions. Global SME digital transformation models often assume relatively stable business environments, strong institutional support, and access to mature innovation ecosystems (Khoza & Mkosana, 2025). However, the African evidence reviewed here demonstrates that AI adoption frequently occurs under conditions of policy uncertainty, infrastructural fragility, and financial scarcity. As a result, AI is deployed pragmatically to enhance short-term resilience, flexibility, and survival rather than long-term technological sophistication. These findings extend international business scholarship by illustrating how digital transformation unfolds in volatile, uncertain, complex, and ambiguous environments where firms rely heavily on external ecosystems rather than internal research and development capabilities. Importantly, African SMEs contribute novel insights to global theory by demonstrating forms of constraint-driven and frugal innovation, where AI is adapted rather than fully integrated, and where innovation is often collective rather than firm-centric (George et al., 2016). Universities, non-governmental organisations, incubators, and development agencies play a disproportionately significant role in enabling AI uptake, contrasting with global North contexts where private technology providers dominate. These ecosystem-based pathways reveal alternative models of competitiveness that are highly relevant for other emerging economies and crisis-prone regions. Consequently, African SME experiences challenge universalist assumptions in international business research and underscore the need for context-sensitive digital transformation frameworks.

CONTRIBUTION TO THEORY AND PRACTICE

This review advances theoretical understanding by reinforcing the perspective that innovation among African SMEs is often constraint-driven rather than opportunity-led, with AI serving as a means of coping with volatility, uncertainty, complexity, and ambiguity. Unlike conventional models of digital transformation, which emphasise long-term strategy and capital-intensive innovation, the findings support an emerging body of literature that views AI adoption in African contexts as adaptive, incremental, and

deeply embedded in local realities (Tchamyou, Somé & Asongu, 2025). This positions AI not as a uniform technological solution, but as a flexible capability shaped by institutional, infrastructural, and socio-economic conditions. The evidence also contributes to resilience and dynamic capability theory by showing how SMEs build digital capacity over time through iterative experimentation, often facilitated by external factors such as NGOs, universities, and incubators (Simba et al., 2025).

On a practical level, the review identifies clear implications for policymakers, ecosystem actors, and SME owners. For policymakers, the findings highlight the urgent need to improve digital infrastructure and create enabling policy environments that reduce ambiguity for AI adoption. This includes standardising data governance, expanding broadband access, and designing gender-inclusive digital strategies (Nakpodia et al., 2024). For innovation ecosystem actors such as accelerators, development agencies, and higher education institutions the review underscores the importance of supporting SMEs not just with technology, but with training, mentoring, and sector-specific toolkits. Public–private partnerships that focus on building digital literacy and co-developing context-sensitive solutions have proven particularly effective (Ebuka, Emmanuel & Idigo, 2023). For SME owners and managers, the findings suggest that AI can be harnessed not only to improve efficiency and responsiveness but also to build long-term resilience. However, this requires an investment in internal capabilities, openness to collaboration, and a clear understanding of which AI tools offer genuine value within constrained operating environments. The review therefore encourages a shift in mindset from viewing digitalisation as a luxury or external trend to recognising it as a core survival and growth strategy.

Comparative Reflections

Compared to global literature, AI adoption among African SMEs exhibits several unique patterns and constraints that distinguish it from trends observed in more developed economies. In high-income settings, AI is typically integrated through strategic investment in enterprise systems, large-scale data infrastructures, and highly specialised digital talent. In contrast, African SMEs often engage with AI through low-cost, mobile-based tools designed to address immediate challenges such as market volatility, operational inefficiency, and information gaps (Ebuka, Emmanuel & Idigo, 2023). This reflects a more pragmatic and improvisational approach to digital transformation, shaped by financial limitations, institutional fragmentation, and infrastructural deficits. While global SMEs benefit from relatively stable regulatory environments and mature digital ecosystems, African SMEs operate in less predictable policy landscapes, often with unclear guidelines on data privacy, cross-border digital trade, and intellectual property (Nakpodia et al., 2024). These gaps increase the risk and complexity of adopting emerging technologies and limit opportunities for AI integration at scale. However, this same context has also fostered innovation under constraint, as seen in the use of AI for decentralised healthcare delivery, informal market logistics, and mobile learning in remote areas (Kosgei & Agwata, 2021). The African experience also underscores the importance of ecosystem-based digital support, with universities, NGOs, and incubators playing a central role in enabling AI uptake through training, mentorship, and subsidised platforms (Simba et al., 2025). These collaborative models are less visible in the global North, where firms typically depend on internal R&D or commercial tech providers. Additionally, the gendered barriers to AI access faced by African female entrepreneurs highlight a critical gap not as prominently discussed in mainstream global literature, pointing to the need for inclusive policy and ecosystem design (Tchamyou et al., 2023). In summary, while African SMEs share global aspirations for competitiveness and innovation, their pathways to AI adoption are shaped by local realities of scarcity, informality, and institutional flux. These comparative reflections suggest that universal models of digital transformation may have limited applicability without contextual adaptation, and that Africa's SME sector offers valuable lessons in resilience-driven innovation that could inform broader theoretical and policy frameworks.

Policy, Theoretical and Practical Implications

Theoretical Implications

Applying the Resource-Based View and Diffusion of Innovations frameworks reveals that AI functions both as a strategic resource and as a socially embedded innovation shaped by contextual conditions. However, the findings also extend Dynamic Capabilities theory by demonstrating how SMEs in resource-constrained environments build adaptive digital capabilities through continuous experimentation and external collaboration rather than internal accumulation alone (Teece, Pisano & Shuen, 1997). Unlike firms in stable institutional settings, African SMEs rely heavily on ecosystem actors to sense technological opportunities and reconfigure operational practices. This highlights the importance of collective capability building and challenges firm-centric assumptions within traditional innovation theory. Furthermore, the integration of Institutional Theory underscores how regulatory uncertainty and governance gaps actively shape innovation trajectories, reinforcing the argument that technology adoption cannot be understood independently of its socio-institutional environment. Together, these theoretical insights contribute to a more nuanced understanding of digital transformation in emerging and volatile economies.

Policy Implications

At the policy level, the findings underscore the importance of creating supportive environments that can lower barriers to adoption. Although AI can significantly improve SME performance, widespread uptake is often hindered by high costs, skills shortages, and infrastructural limitations. Policymakers therefore need to design clear and consistent frameworks that reduce ambiguity and encourage SMEs to experiment with AI. Measures such as tax incentives, affordable digital infrastructure, and targeted training can help level the playing field for smaller firms. Without such interventions, adoption will likely remain uneven and concentrated among better-resourced enterprises, leaving rural and informal SMEs at risk of exclusion.

Practical Implications

For practitioners, the integration of AI has direct and tangible benefits for improving efficiency, productivity, and decision-making. By automating repetitive tasks and enabling data-driven insights, SMEs can reduce costs, manage inventory more effectively, and respond quickly to changing consumer demands (Ayankoya et al., 2025). Predictive analytics, for example, can help firms anticipate market shifts or weather-related disruptions, directly supporting business resilience. However, the practical reality is that many SMEs struggle with adoption due to financial pressures, limited digital skills, and resistance to organisational change (Kwenda & Harrison, 2025). To overcome these constraints, firms must approach AI adoption as a gradual and continuous process of learning and adaptation, requiring commitment to capability development and openness to change.

ACTIONABLE STRATEGIES

Several pragmatic strategies can enable AI to be adopted successfully by resource-constrained SMEs. These include creating public-private partnerships to facilitate collaboration between government and private entities in AI development, as well as offering financial assistance through training programs. These partnerships can unlock public resources for technology training centers, equipping SMEs with necessary AI skills. Additionally, governments should consider national-level policies encouraging AI adoption by providing tax incentives or grants to SMEs utilizing AI-supported solutions. This incentivizes SMEs to invest in the technology and infrastructure needed for effective AI adoption. Another key strategy is developing technology hubs for SMEs to access AI tools, platforms, and expertise. Such hubs create a

shared ecosystem for SMEs to collaborate, share knowledge, and innovate as they work towards implementing artificial intelligence.

FUTURE RESEARCH DIRECTIONS

To further enrich this area of study, future research could explore several topics. One critical avenue is the impact of AI on employment within SMEs, investigating how AI adoption may influence job roles and workforce management strategies. Additionally, examining ethical considerations surrounding AI adoption, particularly focusing on data privacy and potential biases in AI algorithms that could affect decision-making processes, is vital. Lastly, conducting longitudinal studies on AI integration within SMEs can provide invaluable data on performance outcomes and inform the development of adaptive strategies based on continuous monitoring and evaluation of AI's impact over time.

LIMITATIONS OF THE REVIEW

While this review provides a structured synthesis of literature on AI adoption in African SMEs under VUCA conditions, several limitations must be acknowledged. First, the study was limited to two major databases Scopus and Web of Science which, although comprehensive, may have excluded relevant regional or emerging journals not indexed on these platforms. As a result, some valuable local studies, especially those published by African institutions or in practitioner-oriented outlets, may have been overlooked.

Second, the search strategy was based on a specific set of keywords related to AI, SMEs, Africa, and VUCA. This may have constrained the scope of the review by omitting studies that engage with these themes but use alternative terminologies, such as machine learning, digital entrepreneurship, or informal enterprise resilience. Although the Boolean combinations were carefully designed, the complexity and evolving nature of AI-related language present an inherent limitation in literature retrieval.

Third, the review focused only on English-language publications. This linguistic filter may have excluded research conducted in Francophone, Lusophone, or Arabic-speaking African countries, potentially limiting the geographical diversity and cultural representativeness of the findings.

Lastly, the exclusion of grey literature such as policy briefs, NGO reports, conference proceedings, and unpublished theses means that real-world practices, government programmes, and grassroots innovations may not be fully reflected. While the focus on peer-reviewed work ensured methodological rigour, it also limited the inclusion of practical insights that could complement academic perspectives. Taken together, these limitations suggest that future research could benefit from a more inclusive and multilingual approach, expanded keyword sets, and the integration of practitioner literature to deepen understanding of AI's role in African SME ecosystems.

CONCLUSION

This review has shown that African SMEs adopt AI primarily as a practical response to uncertainty and resource constraints, with applications tailored to immediate operational needs. AI tools such as chatbots, predictive analytics, and mobile platforms are used to enhance resilience, efficiency, and innovation, particularly in health, agriculture, and education sectors. However, adoption remains uneven due to weak infrastructure, policy gaps, and limited digital skills, especially in rural and informal settings. Gender disparities also persist, highlighting the need for inclusive interventions. The findings underscore that successful AI integration in African SMEs depends on supportive ecosystems, clear policy direction,

and targeted capacity-building. Overall, the study contributes to the understanding of constraint-driven innovation and highlights the importance of local context in shaping digital transformation pathways.

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STRENGTHENING THE RESILIENCE OF LIVESTOCK MSMES THROUGH COLLABORATIVE GOVERNANCE AND EXPERIENTIAL LEARNING IN INDONESIA

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ABSTRACT

This study examines how collaborative governance influences the effectiveness and sustainability of partnership-based entrepreneurship among livestock micro, small, and medium enterprises (MSMEs) in rural Indonesia. Building on collaborative governance theory and the resource-based view (RBV), the study focuses on the role of institutional arrangements, trust, experiential learning, and cooperative mediation in shaping partnership outcomes. Using a qualitative approach, data were collected through interviews, observations, and document analysis involving 20 stakeholders across Sleman, Purworejo, and Wonosobo. The findings show that cooperative-mediated core–plasma partnerships enhance coordination, learning, and market security, while informal partnerships tend to reinforce power asymmetries. The study contributes to collaborative governance theory by highlighting relational resources as strategic assets and offers policy insights for strengthening inclusive livestock MSME ecosystems.

Keywords: Collaborative governance; Livestock MSMEs; Core–plasma partnership; Cooperative mediation; Experiential learning; Rural entrepreneurship

INTRODUCTION

The livestock sector plays a vital role in rural livelihoods in developing economies by contributing to food supply, employment, and income diversification. In Indonesia, smallholder livestock enterprises—particularly sheep and goat farming—constitute an important segment of rural micro, small, and medium enterprises (MSMEs). Despite their socio-economic significance, livestock MSMEs continue to face persistent structural challenges, including limited access to finance, weak technology adoption, market volatility, and inadequate institutional support. These constraints reduce productivity and weaken competitiveness compared to large-scale agribusinesses with stronger capital and supply chain integration (Kumar & Narayan, 2022; Osei et al., 2023).

To address these challenges, partnership-based models have been promoted as mechanisms to integrate smallholder farmers into organized value chains. One widely adopted approach is the core–plasma partnership system, in which a core enterprise provides inputs, technical assistance, and market access, while plasma farmers manage day-to-day livestock production. This model has been applied in various agribusiness contexts as a means of improving coordination, reducing market uncertainty, and enhancing production efficiency (Kano et al., 2020; Mahajan et al., 2022). When designed effectively, such partnerships can generate mutual benefits for both firms and smallholders.

However, empirical evidence shows that partnership outcomes vary considerably across contexts. In many rural settings, core–plasma arrangements are characterized by power asymmetries, weak contract enforcement, and limited farmer participation, which often undermine trust and long-term sustainability (Nguyen & Freeman, 2021). Studies on SME collaboration further emphasize that governance quality, relational norms, and institutional trust are critical determinants of partnership performance (Liu & Huang, 2022; Farooq et al., 2023). In the absence of transparent governance mechanisms, informal and non-contractual partnerships may reinforce dependency rather than empowerment among smallholder farmers.

Although the literature on agribusiness partnerships and MSME collaboration is growing, most existing studies focus primarily on economic performance, productivity, or contractual efficiency. Comparatively less attention has been paid to the institutional and governance dimensions that shape how partnerships function in practice, particularly in the livestock sector dominated by fragmented smallholders (Reddy et al., 2023; Arbulú Pérez Vargas et al., 2024). The role of cooperative institutions as mediators and the contribution of learning processes within partnership arrangements remain underexplored, especially in developing-country contexts.

This study addresses this gap by adopting a collaborative governance perspective (Ansell & Gash, 2008), complemented by the resource-based view (RBV) of the firm (Barney, 1991). Collaborative governance emphasizes joint decision-making, mutual trust, and shared accountability among public, private, and community actors, while RBV highlights the strategic importance of intangible resources such as knowledge, networks, and institutional legitimacy. Integrating these perspectives enables a more comprehensive understanding of livestock MSME partnerships as socio-institutional systems rather than purely economic arrangements.

Focusing on smallholder livestock MSMEs in Indonesia, this research examines how collaborative governance is implemented within core–plasma partnership models and how cooperative institutions mediate power relations, facilitate experiential learning, and support partnership sustainability. Drawing on qualitative evidence from Sleman, Purworejo, and Wonosobo, the study explores the mechanisms through which trust, learning-by-doing, and institutional coordination influence partnership effectiveness.

By doing so, this research makes three main contributions. First, it extends collaborative governance theory to the underexplored context of rural livestock MSMEs in emerging economies. Second, it integrates RBV to demonstrate how relational and learning-based resources function as strategic assets within partnership governance. Third, it provides empirical insights for policymakers and practitioners seeking to design inclusive and sustainable livestock MSME partnerships through cooperative-based governance structures.

LITERATURE REVIEW

Partnership Models in Livestock MSMEs

Partnership models have long been recognized as strategic mechanisms for integrating micro, small, and medium enterprises (MSMEs) into organized value chains, particularly in agribusiness and livestock sectors. Through partnerships, smallholder producers gain access to critical resources such as inputs, technology, technical assistance, and market channels that are otherwise difficult to obtain independently. One of the most prominent partnership arrangements applied in agribusiness is the core–plasma model, which links large enterprises (core firms) with small-scale producers (plasma farmers) in a coordinated production and marketing system (Kano et al., 2020; Mahajan et al., 2022).

In the livestock sector, the core–plasma model has been adopted to improve production efficiency and reduce market uncertainty by clarifying roles and responsibilities between partners. Core enterprises typically provide breeding stock, feed, veterinary services, and guaranteed market access, while plasma farmers manage daily livestock operations. Empirical studies suggest that such arrangements can enhance productivity and income stability when supported by clear contractual arrangements and effective coordination mechanisms (Osei et al., 2023). However, the effectiveness of livestock partnerships varies considerably across contexts, particularly in developing countries where institutional capacity is uneven.

Several studies highlight that livestock partnerships often suffer from power asymmetries, weak bargaining positions of smallholders, and limited enforcement of contractual agreements. These conditions can lead to dependency relationships that undermine farmer autonomy and long-term sustainability (Nguyen & Freeman, 2021; Tran et al., 2023). As a result, scholars increasingly argue that partnership success depends not only on economic alignment but also on the quality of governance and institutional support underpinning collaborative arrangements.

Collaborative Governance and Institutional Mediation

Collaborative governance provides a useful theoretical lens for understanding how partnerships function beyond formal contracts. According to Ansell and Gash (2008), collaborative governance involves collective decision-making processes in which public agencies, private actors, and community stakeholders engage in dialogue, share authority, and pursue common objectives. Key elements of collaborative governance include trust-building, participatory decision-making, transparency, and shared accountability.

In the context of livestock MSMEs, collaborative governance helps address coordination failures and power imbalances by fostering inclusive institutional arrangements. Studies on SME collaboration demonstrate that governance quality and institutional trust significantly influence partnership performance and sustainability (Liu & Huang, 2022; Farooq et al., 2023). When governance mechanisms are weak or absent, partnerships tend to rely on informal agreements that increase uncertainty and exacerbate opportunistic behavior.

Cooperative institutions play a critical mediating role within collaborative governance systems. Acting as intermediary organizations, cooperatives facilitate coordination between core enterprises and smallholder farmers, reduce information asymmetry, and protect the collective interests of members. Empirical evidence shows that cooperative mediation enhances transparency, strengthens farmer participation, and improves compliance with partnership agreements (Reddy et al., 2023). By transforming bilateral relationships into multi-actor governance arrangements, cooperatives contribute to more balanced and inclusive partnership outcomes.

Recent literature further emphasizes that collaborative governance in MSME ecosystems is increasingly shaped by adaptive policy frameworks and institutional learning. Governments are encouraged to shift from direct control toward facilitative roles that support coordination, capacity building, and monitoring (Home, 2024). Such adaptive governance approaches are particularly relevant in rural contexts where institutional fragmentation and resource constraints persist.

Resource-Based View and Experiential Learning in MSME Partnerships

The resource-based view (RBV) offers additional insights into why collaborative governance matters for MSME partnerships. RBV argues that sustained competitive advantage arises from access to valuable, rare, inimitable, and non-substitutable resources, including intangible assets such as knowledge, networks, and institutional legitimacy (Barney, 1991). For livestock MSMEs, partnerships function as mechanisms for accessing and developing these relational resources.

Through continuous interaction with core enterprises, cooperatives, and government agencies, smallholder farmers acquire technical knowledge, managerial skills, and market information that enhance their adaptive capacity. Experiential learning theory explains this process by emphasizing learning-by-doing, reflection, and adaptation as central to capability development (Kolb, 1984). In livestock partnerships, experiential learning occurs through daily production practices, joint training programs, and problem-solving interactions among stakeholders.

Recent studies confirm that experiential and digital learning significantly improve MSME resilience and innovation capacity. Kim and Lee (2023) show that inter-firm collaboration enhances learning and innovation in rural enterprises, while Arbulú Pérez Vargas et al. (2024) highlight the role of digital skills and self-efficacy in strengthening SME engagement and performance. These findings suggest that learning processes mediate the relationship between governance collaboration and partnership outcomes.

Research Propositions

Synthesizing the above literature, this study is guided by the following research propositions:
Collaborative governance enhances the sustainability of livestock MSME partnerships by fostering institutional trust and participatory coordination (Ansell & Gash, 2008; Farooq et al., 2023).
Cooperative mediation reduces power asymmetry and strengthens relational resources within core–plasma partnership arrangements (Nguyen & Freeman, 2021; Reddy et al., 2023).

Experiential learning mediates the relationship between collaborative governance and livestock MSME resilience, enabling smallholders to adapt practices and improve partnership performance (Barney, 1991; Kolb, 1984; Kim & Lee, 2023).
Moreover, empirical research integrating collaborative governance, cooperative mediation, and experiential learning as interconnected drivers of MSME resilience remains scarce. Existing studies tend to emphasize internal capabilities or bilateral collaboration without considering multi-stakeholder governance structures that characterize partnership ecosystems in rural livestock sectors (Choi & Park, 2019; Kim & Lee, 2021; Park & Kim, 2020). This gap indicates the need for a holistic framework that captures relational resources, institutional coordination, and experiential learning as mutually reinforcing components of MSME resilience.

METHODOLOGY

This study employs a qualitative descriptive approach to examine how collaborative governance is implemented in livestock MSME partnerships and how institutional arrangements shape partnership sustainability. A qualitative design is appropriate because it allows for an in-depth understanding of governance processes, social interactions, and learning dynamics that cannot be adequately captured through quantitative methods (Creswell & Poth, 2018; Silverman, 2020).

Research Sites and Participants

The research was conducted in three districts in Indonesia—Sleman, Purworejo, and Wonosobo—selected purposively to represent different partnership typologies and institutional contexts. Sleman reflects a relatively formal core–plasma partnership supported by cooperatives and government programs, Purworejo represents a semi-formal partnership arrangement, and Wonosobo illustrates smallholder livestock enterprises operating largely through informal cooperation.

A total of 20 informants were selected using purposive and snowball sampling techniques. Participants included smallholder livestock farmers, cooperative leaders, core enterprise managers, and local government officials involved in livestock and MSME development. This diversity of informants enabled the study to capture multiple perspectives on partnership governance and institutional interaction.

Data Collection

Data was collected through three complementary methods: semi-structured interviews, participant observation, and document analysis. Semi-structured interviews focused on partnership experiences, governance mechanisms, trust-building processes, and learning practices among stakeholders. Participant observation was conducted during cooperative meetings, training activities, and routine livestock operations to gain contextual insights into interaction patterns and coordination mechanisms. Document analysis involved reviewing partnership agreements, cooperative reports, and relevant policy documents to support data triangulation.

Data Analysis

Data analysis followed the interactive model proposed by Miles, Huberman, and Saldaña (2014), consisting of data reduction, data display, and conclusion drawing. Interview transcripts and field notes were coded thematically to identify patterns related to governance structures, institutional roles, trust, and experiential learning. The analysis was iterative, allowing emerging insights to be continuously compared with theoretical perspectives on collaborative governance and the resource-based view.

To enhance credibility, triangulation across data sources and methods was applied. Member checking was also conducted by sharing preliminary findings with selected participants to confirm accuracy and interpretation. Ethical considerations were addressed by obtaining informed consent from all participants and ensuring confidentiality throughout the research process.

RESULTS

Institutional Trust and Collaborative Governance

Institutional trust emerges as the foundation of sustainable collaboration among micro, small, and medium enterprises (MSMEs), local governments, and intermediary institutions in Indonesia. The findings indicate that trust operates as both a precondition and a product of collaborative processes—creating a reinforcing cycle between credibility, transparency, and shared accountability. Trust encourages actors to engage in dialogue, share information openly, and make joint decisions, particularly in contexts where bureaucratic rigidity and fragmented governance have long constrained innovation. This finding aligns with the framework proposed by Ansell and Gash (2008), who argue that collaborative governance thrives when institutional arrangements cultivate mutual respect, procedural fairness, and commitment to collective outcomes.

In the three observed regions—Sleman, Purworejo, and Wonosobo—trust between MSMEs and government institutions was initially fragile. Historical patterns of top-down decision-making and

inconsistent program delivery had fostered skepticism among entrepreneurs toward government-led initiatives. However, over time, participatory mechanisms such as multi-stakeholder forums, joint training, and cooperative associations gradually rebuilt confidence. These spaces allowed MSMEs to voice their needs, share success stories, and participate in planning processes. Through repeated interaction, trust evolved from *calculated confidence*—based on transactional benefits—to *relational trust* grounded in shared experiences and mutual understanding.

(Cooperative leader, Sleman; FGD, March 2025):

> "At first we treated government programs like temporary charity — useful but fleeting. After the district invited our cooperative to co-design the training and we saw our suggestions adopted, people began to believe the program was for us, not for show."

This transformation mirrors the relational and cognitive dimensions of social capital (Nahapiet & Ghoshal, 1998). The shift from hierarchical compliance to cooperative engagement signals an institutional learning process where actors recognize interdependence and the value of co-creation. Government officers, previously viewed as regulators, increasingly acted as facilitators who enable partnerships rather than impose control. This role redefinition strengthens legitimacy and nurtures a culture of collaborative problem-solving—a finding consistent with Emerson et al. (2012), who highlight mutual trust as a core driver of integrative governance.

Beyond interpersonal trust, *systemic trust*—confidence in institutional procedures and governance mechanisms—proved essential. MSMEs reported greater willingness to engage in collective projects when local governments demonstrated consistency in policy implementation and transparent budget allocation. The establishment of integrated service centers and digital reporting platforms reduced administrative uncertainty and increased procedural fairness. These institutional innovations correspond with the *process integrity* dimension of collaborative governance, where predictability and accountability sustain long-term cooperation.

(Cooperative manager, Purworejo; interview, April 2025):

> "When the village office posted the list of program beneficiaries and budgets online, suspicions dropped. We could see who got what and why — that built confidence. Even the older members started coming to meetings again."

The data also reveal that trust was not uniform across sectors. In manufacturing and craft-based MSMEs, collaboration was often mediated by cooperative unions that acted as trust brokers. In service and creative industries, personal networks and informal associations remained dominant. This heterogeneity indicates that trust-building mechanisms must be context-specific rather than standardized. As Putnam (2000) asserts, social capital flourishes within the specific norms and values of a community; therefore, institutional trust is embedded within localized social relations.

(Artisan MSME owner, Wonosobo; interview, May 2025):

> "We prefer to rely on fellow artisans. The cooperative tries to help, but for day-to-day problems we call a neighbor first. Trust builds slowly here — through working together at the market."

Moreover, the role of *bridging institutions*—such as universities and non-governmental organizations—was instrumental in enhancing cross-sectoral trust. These intermediaries acted as neutral facilitators that reduced asymmetry between policy makers and entrepreneurs. Their involvement increased the perceived fairness of programs and created a sense of shared purpose. Such institutional brokerage

resonates with the *collaborative advantage* concept (Huxham & Vangen, 2005), where inter-organizational collaboration generates outcomes unattainable by single actors working alone.
(University extension officer, Sleman; field note, March 2025):

> "We don't arrive to 'teach' — we sit with them and map problems together. That posture makes officials listen differently; it reduces the 'us vs them' feeling."

From a theoretical standpoint, these findings reinforce that institutional trust is not merely an antecedent to collaboration but an evolving construct that emerges from continuous interaction. As Bourdieu (1986) and Coleman (1990) noted, trust represents accumulated social capital that becomes productive only when embedded in social structures and supported by institutional norms. Therefore, building trust requires more than short-term incentives—it demands an ongoing commitment to transparency, reciprocity, and shared learning.

The results further demonstrate how trust translates into *governance performance*. In regions with higher levels of institutional trust, collaborative projects exhibited stronger alignment between local development plans and MSME innovation strategies. This alignment produced more coherent policy outcomes and greater resource efficiency. Conversely, in areas where distrust persisted, initiatives suffered from duplication, lack of coordination, and dependency on individual champions. Such disparities confirm Ansell and Torfing's (2021) argument that collaborative governance depends on both procedural integrity and adaptive capacity.
(District livestock officer, Wonosobo; interview, May 2025):

> "Programs often failed because one champion left. Sustainable collaboration needs rules and shared ownership — otherwise progress collapses when personnel change."

Practical mechanisms that supported trust formation included transparent beneficiary selection, joint monitoring committees, and small-scale pilot projects that allowed stakeholders to test arrangements before wider rollout. These incremental approaches reduced perceived risk and increased willingness to commit resources. Regular feedback sessions and participatory budgeting further strengthened accountability and allowed for course corrections, converting episodic projects into sustained collaborative platforms—an approach consistent with adaptive governance literature (Chaffin et al., 2014).

Importantly, trust also influenced entrepreneurs' propensity to share proprietary information and experiment with new practices. In trust-rich environments, farmers were more willing to disclose production records, adopt standardized quality controls, and participate in collective marketing initiatives. This openness enabled cooperatives and core enterprises to design tailored interventions and create economies of scale that benefited all parties. In contrast, where trust was low, actors hoarded information and defaulted to short-term opportunistic behavior, undermining collective efficiency.

(Plasma farmer, Purworejo; FGD, April 2025):

> "At first we did not want to tell the company our feed costs. We feared prices would be cut. After months of meetings and joint accounting exercises, we realized transparency brought better negotiation, not worse."

Finally, the interplay between trust and governance has broader implications for MSME resilience. When trust exists, actors are more likely to share risks, experiment with new models, and sustain partnerships beyond project lifecycles. Trust thus functions as a *governance lubricant* that reduces friction and accelerates collective innovation. The Indonesian case underscores that even in resource-constrained

environments, institutional trust can compensate for limited material capacity by enhancing coordination, reducing opportunism, and promoting collective accountability.

In summary, institutional trust transforms collaborative governance from a procedural arrangement into a socio-political process that cultivates legitimacy, inclusivity, and mutual accountability. Trust does not simply emerge—it is constructed through consistent, transparent, and participatory interactions that redefine relationships among the state, market, and community actors.

Knowledge Sharing and Experiential Learning

Knowledge sharing stands at the heart of collaborative innovation within the MSME ecosystem. The data indicate that effective partnerships evolve not only from formal coordination but from the continuous exchange of experience, problem-solving insights, and adaptive learning among stakeholders. This process reflects Kolb's (1984) experiential learning theory, which posits that knowledge emerges through a cyclical interplay between concrete experience, reflective observation, abstract conceptualization, and active experimentation. Within MSME contexts, this cycle is visible in how entrepreneurs learn by doing—through trial, feedback, and iterative engagement with peers, institutions, and markets.

Across Sleman, Purworejo, and Wonosobo, MSME actors commonly began with limited exposure to formal training programs. However, knowledge dissemination occurred organically through peer learning networks, cooperative mentoring, and community-based innovation workshops. Learning was not restricted to technical skills but extended to governance, marketing, and digital literacy. Such socialized learning underscores the "learning-by-interacting" concept proposed by Lundvall (1992), emphasizing that innovation is an outcome of collective experience rather than isolated genius.
(MSME owner, Sleman; interview, April 2025):

> "We don't really learn from manuals. We learn from watching others. When the cooperative held a joint digital marketing demo, I copied the techniques and adapted them for my batik shop. It worked better than any formal course."

This example reveals how peer-based experiential learning bridges the gap between knowledge and application. The role of cooperatives and associations was crucial in mediating learning flows. They served as knowledge intermediaries that translated abstract policy recommendations into locally relevant practices. In many cases, extension officers and academic partners facilitated learning forums where MSMEs shared their daily operational challenges and co-designed solutions. These forums became spaces for reflective learning and problem reframing—aligning with Wenger's (1998) concept of communities of practice, where learning occurs through shared participation in a common enterprise.
(University facilitator, Wonosobo; FGD, March 2025):

> "We stopped giving lectures and started facilitating discussions. Each MSME shared one success and one failure from the last month. The failures were more valuable—they taught everyone what not to repeat."

The learning processes also revealed a distinct cultural dimension. In collectivist societies like Indonesia, the willingness to share knowledge is influenced by social harmony and reciprocity. While knowledge sharing may appear informal, it operates within strong moral obligations of mutual aid (gotong royong). This cultural trait reinforces trust and accelerates the diffusion of best practices across enterprises. However, it also implies that knowledge remains embedded in personal relationships, limiting scalability without institutional support.
(Community leader, Purworejo; interview, May 2025):

> "Here, we don't withhold ideas—but we share them only with people we know well. It's about trust and respect. Outsiders must first show commitment before we open up."

This pattern reflects the tension between bonding and bridging social capital (Putnam, 2000). While close-knit networks foster deep trust, they may hinder broader learning across clusters. Therefore, effective knowledge sharing requires mechanisms that balance intimacy with openness. Cross-community learning events, inter-regency exhibitions, and digital platforms emerged as tools to extend the reach of local innovations while preserving the integrity of existing social ties.

Another insight from the field was the significance of learning from failure. MSME actors often viewed setbacks as shared learning opportunities rather than individual shortcomings. This mindset aligns with Argyris and Schön's (1978) concept of double-loop learning, where organizations challenge underlying assumptions rather than merely correcting immediate errors. By institutionalizing reflection sessions after project completion, cooperatives and local governments facilitated collective evaluation and adaptive redesign.
(Cooperative chairperson, Sleman; FGD, April 2025):

> "When our first collective e-commerce site failed, we didn't blame anyone. Instead, we asked, 'What went wrong?' That's when we realized we needed better photos and simpler payment methods. The second version succeeded because of that."

Experiential learning also occurred across institutional boundaries. Government officers learned to simplify procedures after observing entrepreneurs' constraints, while MSMEs adapted administrative habits by engaging in joint reporting exercises. These reciprocal adjustments illustrate co-learning processes where all parties evolve through mutual feedback. The iterative feedback loop, combining practical experimentation and institutional learning, produced adaptive governance outcomes consistent with Senge's (1990) learning organization framework.
(Local government official, Wonosobo; interview, March 2025):

> "We used to ask MSMEs to fill out long forms. After attending their sessions, we realized half couldn't access the forms digitally. Now we help them complete it directly during meetings. That small change built huge trust."

Digitalization also transformed the nature of learning. Social media groups, WhatsApp clusters, and online webinars became new platforms for peer-to-peer knowledge exchange. These tools democratized access to information and enabled asynchronous collaboration. Yet, they also introduced digital divides, especially for older entrepreneurs or those in remote areas. In some cases, younger MSME members became informal digital mentors for their communities, fostering intergenerational learning.
(Youth MSME mentor, Purworejo; interview, May 2025):

> "My parents' group refused to join online markets. I created short video guides and shared them in our WhatsApp group. Within two weeks, five of them started selling online for the first time."

From a governance perspective, experiential learning transformed relationships among stakeholders. Rather than perceiving government as a supervisor, MSMEs began to see it as a partner in experimentation. Local officials, in turn, recognized that flexible, iterative policies were more effective than rigid regulations. This dynamic resonates with the adaptive governance approach (Folke et al., 2005), which highlights responsiveness, feedback, and collaborative learning as key to resilience in complex systems.
(MSME digital trainer, Sleman; FGD, April 2025):

> "Policies change slower than markets. Instead of waiting for new regulations, we experiment with small pilots. If it works, the government later formalizes it. That's how we move faster."

Importantly, knowledge sharing was found to enhance collective efficacy—a shared belief that the group can achieve goals together. As MSMEs witnessed tangible improvements through collaborative learning, confidence in joint problem-solving grew. This aligns with Bandura's (1997) notion that collective mastery experiences strengthen motivation and sustain participation. The growth of this collective efficacy also reinforced the "trust–learning–innovation" cycle central to the OASIS model.

Nevertheless, barriers remained. Time constraints, limited facilitation skills, and power asymmetries occasionally hindered open dialogue. Smaller enterprises often felt intimidated by larger players, reducing their willingness to share problems publicly. To mitigate this, some cooperatives adopted rotational facilitation or breakout groups to ensure balanced participation. Such procedural innovations mirror the inclusivity principle emphasized in collaborative governance frameworks (Emerson et al., 2012).
(Small-scale MSME participant, Wonosobo; FGD, April 2025):

> "When big companies dominated discussions, we stayed silent. But when the facilitator let us work in small groups, we spoke freely. Later, our ideas were used in the main plan—that made us proud."

Cumulatively, these learning processes transformed not only technical competence but also institutional culture. Government and MSME actors jointly constructed meaning, generating shared mental models that bridged administrative and entrepreneurial worldviews. As learning deepened, collaboration shifted from compliance to co-creation, echoing the co-production principles of Ostrom (1996).
(Regional cooperative officer, Purworejo; interview, May 2025):

> "In the past, we delivered training and left. Now, we co-design every step. The entrepreneurs remind us that policy isn't effective unless they can practice it. We learned humility."

In summary, experiential learning within the OASIS framework demonstrates that knowledge exchange is not a unidirectional transfer but a social process of joint reflection and adaptation. By embedding learning in relationships of trust, stakeholders transform knowledge into action and experience into innovation. This dynamic reciprocity establishes the foundation for the next component of the model: Collaborative Innovation and Digital Adaptation, where shared learning evolves into collective experimentation and technological advancement.

Collaborative Innovation and Digital Adaptation

The evolution of collaborative innovation among MSMEs in Indonesia reflects a transition from isolated, efficiency-driven entrepreneurship toward an ecosystemic model grounded in shared experimentation and co-design. The findings reveal that collaboration stimulates innovation not merely by pooling resources, but by expanding the cognitive and institutional diversity available to solve complex problems. As Lundvall (1992) argues, innovation is a learning process embedded within social interaction. The MSME cases in Sleman, Purworejo, and Wonosobo illustrate how such interaction, when supported by trust and experiential learning, becomes the foundation for adaptive innovation systems.

In Sleman, innovation primarily emerged through cross-sectoral partnerships that linked cooperatives, local universities, and government incubators. These partnerships enabled MSMEs to access technical expertise, digital infrastructure, and mentoring previously unavailable to them. Entrepreneurs co-

developed new products and digital marketing strategies under guidance from academic partners, thereby translating tacit knowledge into market-oriented innovations.
(MSME entrepreneur, Sleman; FGD, March 2025):

> "When we worked with the university, it wasn't about lectures. They helped us redesign packaging, create online catalogues, and track customer responses. We learned to test ideas fast and see what customers liked. That changed everything."

Such collaboration aligns with the triple helix model (Etzkowitz & Leydesdorff, 2000), which emphasizes the dynamic interaction between academia, industry, and government in fostering innovation. The research found that where the triple helix partnership was active, digital adoption increased rapidly. MSMEs began using e-commerce, digital payments, and social media analytics to expand their market reach. The introduction of shared digital tools also facilitated transparency and coordination within supply chains.
(Cooperative manager, Purworejo; interview, April 2025):

> "Before digital apps, we had to call or meet in person to update stock. Now, with the shared dashboard, every member sees real-time sales. It saves time and reduces conflict."

The transition to digitalization was, however, not merely technological but cultural. Many MSME owners had to unlearn habits of secrecy and adopt collaborative approaches to information sharing. This cultural shift was often mediated by younger, tech-savvy members who bridged generational and digital divides. In several cases, these "digital champions" acted as informal trainers within cooperatives, creating a cascading effect of innovation diffusion.
(Youth mentor, Wonosobo; interview, May 2025):

> "We didn't wait for formal training. Once I learned how to use the online marketplace, I taught my group. Then they trained others. Within two months, twenty businesses were online."

Digital transformation also required institutional flexibility. Local governments that embraced adaptive policies—such as simplifying licensing procedures and subsidizing online training—helped accelerate MSME innovation. These adaptive policy responses demonstrate the principles of collaborative innovation governance (Torfing, Sørensen, & Røiseland, 2019), where innovation emerges from co-created problem definitions and shared experimentation rather than top-down directives.
(District official, Purworejo; FGD, April 2025):

> "We learned that innovation cannot be ordered. It must be facilitated. Instead of dictating solutions, we ask entrepreneurs what obstacles they face, then co-create pilot programs around their answers."

At the network level, collaborative innovation often took the form of collective experimentation. MSMEs tested new marketing approaches, financial models, or production techniques in small groups before scaling up. Failures were shared openly in reflection sessions, reinforcing a culture of mutual learning rather than blame. This iterative process is consistent with the innovation-as-learning approach (Kline & Rosenberg, 1986), in which technological change results from cumulative feedback across social and institutional boundaries.
(Craft producer, Sleman; FGD, March 2025):

> "We tried exporting handmade baskets through one platform. It failed because of shipping costs. But from that failure, we learned to bundle products locally and sell through micro-influencers. That worked better."

Interestingly, the study found that digital adaptation reshaped power dynamics within MSME ecosystems. Previously marginalized actors—particularly women and youth—gained visibility and agency through online platforms. Female entrepreneurs who once relied solely on local markets accessed broader audiences and diversified income streams. The democratization of innovation thus produced social inclusion outcomes consistent with inclusive innovation theory (Heeks, 2013).
(Woman entrepreneur, Purworejo; interview, May 2025):

> "Before going online, my batik business depended on tourists. During the pandemic, sales stopped. Through Instagram and Shopee, I reached customers in other cities. Now 60 percent of my buyers are from outside the region."

However, digital transformation also revealed new inequalities. Not all MSMEs could afford the technology or possessed the digital literacy needed to fully benefit. Smaller enterprises often struggled to maintain digital visibility amid competition from larger players. Some cooperatives addressed this by forming digital solidarity clusters, where members shared costs and managed collective online shops. These arrangements echoed Elinor Ostrom's (1990) principles of shared resource governance—adapted to the digital economy.
(Cluster leader, Wonosobo; FGD, April 2025):

> "We can't compete alone. So, we created one online shop for the entire cluster. Each member contributes photos and updates. The profits are distributed based on sales. It's fair and efficient."

The sustainability of innovation depended on continuous capacity-building. The most successful initiatives combined technical training with mentorship and peer learning. This integrated approach mirrors the innovation capability-building framework (Bell & Pavitt, 1993), emphasizing that skills, routines, and institutional learning are co-evolving. In several instances, collaborative digital innovation produced spillover effects—such as improvements in supply chain coordination, financial transparency, and branding consistency.
(Cooperative treasurer, Sleman; interview, April 2025):

> "Now we can track every transaction digitally. Mistakes are fewer, reports are automatic, and members trust the numbers. Transparency itself became our innovation."

From a theoretical standpoint, collaborative innovation in these MSME ecosystems illustrates the convergence of social learning and technological adaptation. The innovation process was not driven by individual creativity but by collective sense-making. Through dialogue and experimentation, actors co-produced knowledge that aligned with local needs and resource constraints. This confirms the argument of Von Hippel (2005) that users often become innovators when empowered by participatory design processes.
(Local innovation facilitator, Purworejo; interview, April 2025):

> "We realized that the best ideas come from users themselves. Entrepreneurs already knew their markets; we only helped connect them to tools and partners."

Challenges to sustaining innovation included funding limitations, inconsistent internet connectivity, and regulatory lag. Yet, these constraints also prompted frugal innovation strategies—creative, low-cost solutions adapted to local realities (Radjou & Prabhu, 2015). For instance, entrepreneurs developed offline marketing kits for areas with limited connectivity and experimented with hybrid delivery systems combining digital orders and manual distribution.
(MSME logistics coordinator, Wonosobo; FGD, May 2025):

> "Some villages have poor signal. So, we print QR codes and take them to the weekly market. Customers scan them later when they have internet access. It's a small trick, but it works."

Overall, the interplay between collaboration and digital adaptation highlights the importance of adaptive capacity—the ability to learn, reorganize, and innovate under uncertainty (Folke et al., 2005). The OASIS framework demonstrates that adaptive innovation arises not from isolated technology adoption, but from a participatory process of collective problem-solving embedded in trust and shared learning. The institutional networks, cooperative culture, and digital pathways that emerge from such collaboration form the foundation of resilient local innovation systems.
(Policy analyst, Central Java Provincial Office; interview, June 2025):

> "We see MSMEs as innovation ecosystems, not just small businesses. They are laboratories of adaptation—where policy, technology, and social learning meet."

Systemic Integration and Policy Implications

The final analytical dimension of the OASIS framework—systemic integration—highlights how collaborative practices among MSMEs, government institutions, and intermediary actors evolve into a coherent innovation system. The preceding findings demonstrate that trust, knowledge sharing, and digital collaboration are not isolated mechanisms; rather, they constitute an integrated cycle of mutual reinforcement that sustains MSME resilience. When collaboration becomes institutionalized across multiple levels—organizational, inter-sectoral, and policy—the ecosystem transitions from fragmented interventions to systemic governance for innovation.

This integrative process reflects the logic of innovation systems theory (Lundvall, 1992; Edquist, 2005), which views innovation as a function of institutional interaction rather than individual capability. In this perspective, MSMEs, cooperatives, universities, and local governments function as nodes within a distributed learning network. The efficiency of this system depends on the density of connections and the quality of feedback mechanisms. The evidence from the three study sites suggests that regions where collaboration became institutionalized exhibited higher levels of adaptive capacity and policy coherence.
(Policy officer, Purworejo; interview, May 2025):

> "When MSMEs, cooperatives, and universities meet regularly, policies stop being abstract. We can test ideas quickly, see what works, and scale it through formal programs. That's how learning becomes policy."

The integration of collaboration into policy structures occurred through several pathways. First, institutional embedding, where informal partnerships were formalized into memoranda of understanding (MoUs), joint funding schemes, or permanent advisory boards. This institutionalization ensured continuity beyond project cycles and prevented dependency on individual champions. Second, policy alignment, as seen in the synchronization of MSME innovation targets with regional development plans (Rencana Pembangunan Daerah). Finally, capacity harmonization, in which training curricula and business facilitation programs were co-developed by government agencies, cooperatives, and universities to maintain consistency of knowledge transfer.
(Cooperative network coordinator, Sleman; FGD, April 2025):

> "Before, every department had its own program. Now, we meet quarterly with the local government and university to coordinate. The topics align, and MSMEs get continuous support instead of fragmented help."

The systemic integration also involved creating feedback institutions that connect grassroots innovation with policy reform. MSME forums, participatory evaluations, and digital reporting systems acted as feedback loops, translating local experimentation into regulatory insight. Such iterative structures align with the adaptive governance paradigm (Folke et al., 2005), where learning and flexibility underpin resilience. In this sense, policy is not a static command structure but a dynamic framework shaped by continuous dialogue between implementation and reflection.
(MSME leader, Wonosobo; interview, May 2025):

> "We report results through an online dashboard. The government actually reads them. Last year, our input changed the grant criteria for small producers. That made us feel we are part of the policy, not just its subjects."

From a systemic perspective, the OASIS framework contributes to bridging the persistent gap between policy design and policy practice. Traditional MSME policies often emphasize financial assistance or infrastructure but overlook the relational and learning dimensions that enable long-term innovation. The findings reveal that integrated collaboration transforms policy from a distributive mechanism into a co-creative governance process. This supports Ansell and Torfing's (2021) argument that collaborative innovation regimes can enhance democratic legitimacy and policy adaptability by embedding experimentation and stakeholder engagement within public administration.
(Academic advisor, Central Java; field notes, June 2025):

> "The success of the MSME digital program wasn't about money. It was about listening, testing, and learning together. Policy should be less about control, more about facilitation."

The integration of the OASIS principles—trust, learning, innovation—also produced spillover effects beyond MSME performance. In Sleman, enhanced collaboration led to regional branding initiatives that linked tourism, crafts, and agri-business sectors. In Purworejo, the institutionalization of cooperative-led digital marketplaces increased rural women's income and reduced unemployment. In Wonosobo, collaboration around sustainable packaging fostered environmental awareness and circular economy practices. These systemic outcomes exemplify collective impact (Kania & Kramer, 2011), where multiple actors align their efforts around shared measurement systems and mutually reinforcing activities.
The integration of digital infrastructure further accelerated system-level coherence. By linking databases across agencies, the regional governments reduced duplication and improved monitoring. Real-time data on MSME activities informed strategic decisions on training, funding, and market expansion. This data-driven governance reflects the smart regional development concept (Komninos, 2015), where technology enhances participatory and evidence-based policymaking.
(IT officer, Sleman; interview, April 2025):

> "Before digital integration, we couldn't track MSME growth accurately. Now we see which sectors thrive, which need support, and adjust programs faster."

From a policy standpoint, systemic integration promotes three key lessons. First, collaboration must be institutionalized, not project-based. Sustainable innovation requires consistent structures and permanent coordination mechanisms that survive political transitions. Second, learning should be embedded in policy, allowing iterative adaptation through participatory evaluation and open data. Third, digital inclusion must accompany digitalization, ensuring that marginalized MSMEs are not excluded from innovation opportunities due to technological barriers.
These insights reaffirm that innovation ecosystems thrive when governance becomes open, adaptive, and inclusive—the three core attributes of the OASIS model. When these principles are integrated systemically, MSMEs evolve from economic actors into institutional co-creators of local development.
(Provincial development official, Central Java; interview, June 2025):

> "We've learned that innovation policy cannot be written in offices. It must be co-produced in the field, where entrepreneurs, cooperatives, and officials learn together."

In conclusion, systemic integration represents the culmination of collaborative evolution within MSME ecosystems. By linking micro-level collaboration to macro-level governance, it transforms fragmented local practices into structured, adaptive systems. The OASIS framework thus provides a theoretical and practical pathway for scaling collaborative innovation—where institutional trust, experiential learning, and digital adaptation converge into sustainable regional development.

CONCLUSION AND IMPLICATIONS

This study examined how collaborative governance shapes the sustainability and effectiveness of partnership-based entrepreneurship among livestock micro, small, and medium enterprises (MSMEs) in rural Indonesia. Drawing on qualitative evidence from Sleman, Purworejo, and Wonosobo, the findings demonstrate that partnership performance is not determined solely by economic incentives or contractual arrangements, but by the quality of governance, institutional trust, and experiential learning embedded within collaborative processes.

The results show that institutional trust functions as the cornerstone of sustainable collaboration. Trust is both a prerequisite and an outcome of collaborative governance, evolving through participatory decision-making, transparency, and consistent institutional behavior. Cooperative institutions play a critical mediating role by reducing power asymmetries between core enterprises and smallholder farmers, facilitating dialogue, and safeguarding collective interests. In contexts where cooperative mediation and participatory mechanisms are weak, partnerships tend to rely on informal arrangements that reinforce dependency and limit long-term resilience.

The study further highlights the importance of experiential learning and knowledge sharing as mechanisms that translate collaborative governance into tangible capability development. Through learning-by-doing, peer interaction, and reflection on success and failure, MSMEs enhance technical, managerial, and adaptive capacities. These learning processes not only strengthen individual enterprises but also foster collective efficacy and innovation within local ecosystems. The integration of collaborative governance with the resource-based view thus illustrates how relational resources—trust, knowledge, and networks—operate as strategic assets that underpin partnership sustainability.

From a theoretical perspective, this research contributes to the literature in three ways. First, it extends collaborative governance theory to the underexplored context of rural livestock MSMEs in developing economies. Second, it integrates the resource-based view by demonstrating how relational and learning-based resources are generated and mobilized through governance arrangements. Third, it advances the OASIS framework by empirically showing how trust, experiential learning, and collaborative innovation interact as an integrated system rather than isolated dimensions.

Managerial Implications

For practitioners, the findings suggest that core enterprises and cooperatives should move beyond transactional partnerships toward governance models that emphasize transparency, participation, and continuous learning. Managers are encouraged to invest in trust-building mechanisms such as joint planning forums, shared monitoring systems, and open information exchange. Cooperative leaders, in particular, should strengthen their role as intermediaries that mediate conflicts, facilitate learning, and ensure equitable benefit distribution among members.

Policy Implications

From a policy perspective, the study underscores the need for governments to adopt facilitative rather than directive roles in livestock MSME development. Policymakers should strengthen cooperative-based governance structures, provide legal and institutional support for transparent partnerships, and institutionalize participatory platforms that allow MSMEs to engage in policy design and evaluation. In addition, digitalization strategies must be accompanied by inclusive capacity-building programs to prevent the exclusion of smaller or less technologically literate enterprises.

Overall, the study concludes that sustainable livestock MSME partnerships require collaborative governance systems that integrate institutional trust, experiential learning, and adaptive innovation. By embedding these principles into cooperative institutions and public policy, rural livestock MSMEs can enhance resilience, reduce power asymmetries, and contribute more effectively to inclusive rural development.

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ECONOMIC GROWTH, POVERTY, AND HUMAN DEVELOPMENT INDEX

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ABSTRACT

This study explicitly identifies a gap in the literature by focusing on low-HDI provinces in Indonesia a context rarely explored in depth and using 2015–2019 BPS panel data to analyze complex temporal dynamics. The problem statement is the ambiguity regarding how economic growth and poverty simultaneously affect HDI in underdeveloped regions, with the main finding being surprising as it contradicts conventional hypotheses: economic growth does not always have a significant positive impact, while the influence of poverty on HDI is proven to be more nuanced than traditionally assumed. This study investigates the impact of economic growth and poverty on the Human Development Index (HDI) in four provinces classified under the low HDI category in Indonesia. Using data published by the Central Bureau of Statistics from 2015 to 2019, the research explores the dynamic relationship between these variables over time. The analysis employs econometric modeling with e-views as a tool for hypothesis testing, allowing for a strong evaluation of the proposed framework. Contrary to expectations, the findings reveal surprising results, indicating that economic growth and poverty have complex and nuanced influences on HDI that challenge traditional assumptions. The study concludes by offering insights for policymakers to design more effective, targeted strategies that address the unique challenges of provinces with low HDI levels. Recommendations for future research include incorporating additional variables, such as education quality and healthcare access, to provide a more comprehensive understanding of HDI determinants. These findings contribute to the broader discourse on sustainable development and the interconnectedness of economic growth, poverty alleviation, and human well-being.

Keywords: economic growth, Human Development Index (HDI), poverty

JEL Code : O10, C87, I32

INTRODUCTION

The achievement of economic development can be seen in the success of human development. Human development can be defined as expanding people's choices to live freely and with dignity and expanding capabilities to fulfill aspirations. Human development also means positive changes in the whole

person, focusing on society and its welfare and being the ultimate goal of all kinds of development (BPS, 2020). Human development is an essential issue in economic development because it involves the quality of human resources, so it needs attention. There are two reasons underlying human development that need attention (Ginting et al., 2008). First, many developing countries have succeeded in achieving high economic growth but have yet to reduce the human development gap. Second, human resources are input in economic growth; if human development is successful, the quality of human resources will improve to accelerate economic growth.

The United Nations Development Program (2019) created the Human Development Index (HDI) indicator to measure human development development. HDI covers three things that are considered very basic, namely (i) the health sector life span; (ii) the education sector: knowledge; and the economic field, a decent standard of living (Faqihudin, 2010). UNDP distinguishes the level of human development index based on four classifications, namely: very low (HDI<50%), low (HDI between 50% and 65.99%), high (HDI between 66% and 79.99%), and very high (HDI 80% and above) (Ginting et al., 2008). The purpose of measuring HDI is to develop indicators that measure the basic dimensions of human development and the expansion of freedom of choice, utilize several indicators to keep the measure simple, and create measures that include social and economic aspects (Wicaksono, 2014). The increase in HDI is driven by economic growth because economic growth is the main requirement, so economic growth must be accompanied by sufficient conditions, namely development equity (BPS, 2020). The existence of equitable development guarantees that all residents can enjoy the results of development. The condition for equitable development that is achieved will accelerate HDI (Wicaksono, 2014).

The new growth theory emphasizes the vital role of government, especially in increasing human resources (Suliswanto, 2010). Improving the quality of human resources can be shown by increasing one's knowledge and skills to encourage an increase in a country's productivity, which impacts economic performance. Several important factors in development that are very effective for human development are education and health. Education and health are basic human needs that must be possessed in order to be able to increase their potential. The higher the basic capabilities a nation possesses, the higher the opportunity to increase the nation's potential. The demands on basic capabilities are felt to be higher; if they do not become demands, the nation will be unable to compete with other, more advanced countries (BPS, 2020f).

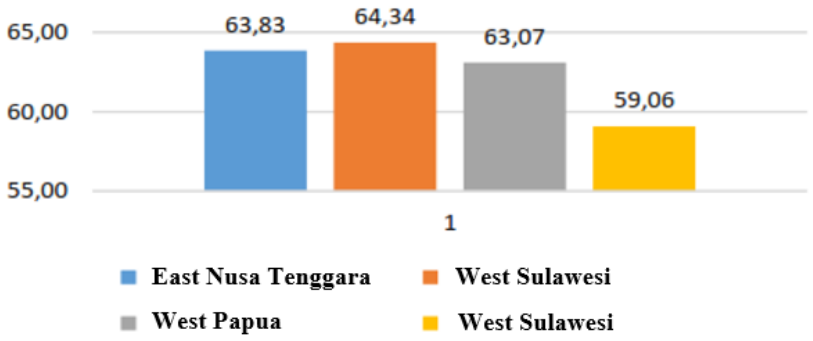

Figure 1. Average Human Development Index 4 Provinces in Indonesia which are included in the Low Category in 2015-2019 *Source: BPS (2020)*

Figure 1. shows that the province of Papua has the lowest HDI compared to the other three provinces. The HDI for Papua Province, on average from 2015-2019, was 59.06%. The low HDI in Papua Province is due to the government's lack of role in improving human development in three fields: education, economy, and health in Papua Province, coupled with many poor people (BPS, 2020b). Economic growth is seen as a variable that has a role in driving and encouraging human development. Economic growth and

human development are related and mutually contribute to one another (Anggraini & Muta'ali, 2013). UNDP (2019) revealed that the quality of human development can increase if it is supported by high economic growth and balanced with equal income distribution. Economic growth will be very effective in improving human development. Economic development contributes to human development through government revenue so that government increases can be invested in human development (Anggraini & Muta'ali, 2013).

Poverty is a problem in development that can affect HDI. Poverty can also severely affect human development because poverty is a complex problem that stems from the purchasing power of people who cannot cover basic needs, so other needs, such as education and health, are neglected (Mirza, 2012). It makes the gap in human development between the two even more significant, and in the end, the HDI achievement targets set by the government are not appropriately realized. Chalid and Yusuf (2014) revealed that the poverty rate and unemployment rate have a negative effect on HDI, while district/city minimum wages and the rate of economic growth have a positive effect on HDI. In his research results, also shows that capital expenditure and economic growth have a positive effect on HDI. However, the poverty rate has a negative effect on HDI in Central Kalimantan. The research results of Mirza (2012) showed that the development of the human development index in the medium category during the 2006-2009 period was able to achieve the HDI targets set by the central government, while poverty and capital expenditure had a negative and significant effect on HDI, economic growth also had a positive and significant effect on HDI.

HDI 4 Provinces in Indonesia that are in the low category need to be given more attention by the central and regional governments compared to 30 other provinces in Indonesia that are in the high category because the 30 provinces that are included in the high category describe the HDI level at a pretty good level and not worrying. Meanwhile, these four provinces are experiencing worrying problems because the HDI is still in the low category. Therefore, the government needs serious attention to implement policies that can increase the HDI to catch up with the other 30 provinces already in the upper medium.

Using a new HDI calculation methodology, this study uses average HDI data released by BPS for 2015-2019. Two reasons were used for changes in the HDI calculation methodology (BPS, 2020e). First, the literacy rate is no longer relevant in measuring education because it cannot fully describe the quality of education, so it is replaced by the expected length of schooling and the average length of schooling. Literacy rates in most regions are already high, so they cannot distinguish good levels of education between regions. In addition, Gross Domestic Product (GDP) was replaced with per capita Gross National Income (GNP) because it was considered unable to describe the income of the people of a region. Second, the use of the geometric mean formula in the HDI calculation illustrates that low performance in one dimension can be covered by high performance in other dimensions.

This study differs from previous research because it specifically focuses its analysis on provinces with the lowest HDI category in Indonesia, and reveals the complex and not always linear relationship between economic growth, poverty, and human development often challenging the traditional assumption that economic growth automatically has a positive and significant impact on HDI. Thus, the research gap that this paper aims to fill is the lack of empirical studies that specifically explore the dynamics of this relationship in the context of disadvantaged regions in Indonesia using the latest panel data (2015-2019) and econometric approaches, so this study seeks to provide more nuanced empirical evidence to enrich the discourse on sustainable development in regions with the most pressing human development challenges. The 2015-2019 analysis period was selected based on the availability of consistent and comparable data from the Central Statistics Agency (BPS), considering that in 2015 BPS refined the methodology for calculating the Human Development Index by adopting new components such as average years of schooling and expected years of schooling in line with UNDP standards. Furthermore, 2019 was chosen as the analysis deadline because it was the last year before the COVID-19 pandemic, which had the potential to create data distortions due to extreme economic and social shocks, and also because it was the period in which the

latest version of the HDI measurement had been fully implemented and produced more accurate data in reflecting human development achievements at the provincial level.

LITERATURE REVIEW

Human Capital Theory

Jhingan (2016) says human capital is obtaining and enhancing human beings with expertise, education, and experience that impact economic development. According to Schultz (1993), the development of human resources five ways: (1) health facilities and services, which include spending to affect life expectancy; (2) skills training; (3) formal education such as elementary, middle, and high levels; (4) informal education such as training in the agricultural sector; (5) migration for job opportunities.

There are several types of investment, namely education, training, migration, and looking for a new job to get a higher income (Ehrenberg et al., 2021). One of the most important human capital is education. To get a higher education of course costs, with the hope that these costs can be replaced with higher income. Apart from formal education, investment in education is also obtained through job training and experience.

According to Borjas (2013), education and experience are valuable in increasing future income. The theory of human capital assumes that a person will get a better level of welfare by increasing education (Becker et al., 1990). A high level of education will provide opportunities to get a better job. Jobs with higher wage rates will increase welfare (Becker, 2009). Therefore, the expectation of a better job is realized by increasing education. Every additional year of school problems has an impact on adding skills and opportunities to get a better job, but on the other hand, this delays one year's receipt of one's income because one year is used for school (Becker, 1993).

Human capital is structured through two things, namely, education and training. These two things can improve a worker's skills, which impacts someone's freedom to choose a job. Human capital also determines the productivity of a company or agency. This productivity is measured based on the output that a worker can produce. Improving the quality of human capital will impact output production, which is getting better in terms of quality and quantity.

According to Psacharopoulos (1985), people who use maid services generally know that the average higher education graduate has relatively superior individual characteristics, so he has a higher income than the average low-income person. The labor market prioritizes workers with higher education because higher education can be placed in a particular section with the same wage as those with low education. Individuals with higher education will be more flexible in entering the labor market.

Cost and Benefits of Increasing Human Capital

Regarding the costs and benefits of increasing human capital through education, there are individual costs and benefits and social benefits costs of education. Todaro and Smith (2020) state that individual education costs, namely costs that students of their own families must bear, will increase more slowly or may even decrease, while the benefits of individual education are the hope for someone more educated to get a better income.

Social costs of education are opportunity costs that society must bear due to the need to finance the expansion of higher and more expensive education with funds that may be more productive when used in other economic sectors. When compared to individual costs and social costs, the benefits of education for society as a whole (social costs) are much smaller than the individual benefits (individual costs) (Todaro & Smith, 2020).

A capital increase will spur higher levels of demand for education, but the creation of opportunities for higher education will result in increased social costs borne by society. Communities must also bear social costs through worsening resource allocation, ultimately reducing the supply of funds and opportunities to create direct employment opportunities or to carry out other development programs (Todaro & Smith, 2020).

Economic Growth Theory

According to Smith's Classical Economics, output is influenced by two main factors: total output growth and population growth. The theory put forward by Smith also explained that initially, an increase in the labor force would lead to an increase in per capita income. However, an increasing population would result in diminishing returns or marginal production. This situation causes per capita income to reach its maximum value. The population at the highest point is called the optimal population. If the population continues to increase and exceeds the optimal point, population growth will cause a decrease in output.

The Harrod-Domar growth theory emphasizes the importance of investing in replacing or adding to capital goods that can increase economic growth. The Harrod-Domar growth theory explains that every net addition to the capital stock in the form of new investment will increase the flow of national output or Gross Domestic Product. Harrod-Domar uses three components that affect economic growth (Todaro & Smith, 2020), namely the capital-output ratio (k), national saving ratio (s), and the amount of new investment determined by the amount of total savings (S). Savings (S) is part of a certain amount, or S, of national income (Y).

The Solow neoclassical growth model is a pillar that significantly contributes to the neo-classical growth theory, which is also a development of the Harrod-Domar formulation by adding a second factor, namely labor, and introducing a third independent variable, namely technology, into the growth equation. The Solow growth model is designed to show how growth in capital stock, labor force, and technological advances interact in the economy and how they affect a country's overall output of goods and services. The Solow model explains that the increase in output, in the long run, is determined exogenously; in other words, it is determined outside the model. The Solow model predicts that, eventually, there will be convergence in the economy toward a steady-state growth condition that depends only on technological developments and workforce growth. Steady-state conditions show long-term economic equilibrium (Mankiw, 2020).

Growth theorists such as Romer (1986) and Lucas Jr (1988) explained that new growth theory, better known as endogenous growth theory, emerged because they were dissatisfied with the neo-classical model, which was insufficient to explain long-run growth. In the neo-classical growth model, technological change is assumed to be exogenous. In contrast, neo-classical growth without technological change predicts that the economy will eventually converge to a steady state and diminishing returns to capital (Barro, 2003). Romer (1986) describes a growth model with aggregate increasing returns where the equilibrium of an endogenous growth model with technological changes and forward-looking and profit-maximizing agents can encourage long-run growth through knowledge accumulation. Romer also developed a further model regarding the implications of human capital development at the level of economic growth in which technology is assumed to be a non-rival and partially excludable good, or in other words, there are externalities and spill-over effects, which will lead to an endogenous growth model.

Developing countries, in general, are caught in a "vicious circle of poverty." The cycle of poverty is defined as a series of forces that mutually influence one another to create a condition where a country will remain poor and experience difficulties in achieving a higher level of development (Nurkse, 1953).

Poverty is not only caused by the absence of development in the past; poverty is also a factor inhibiting development in the future (Drechsler, 2009). One of the factors identified as the cause of poverty is the intense obstacles in capital formation (Arsyad, 2010).

HYPOTHESIS DEVELOPMENT

The Relationship between Economic Growth and the Human Development Index

Economic growth is defined as an increase in gross domestic product/gross national income regardless of whether the increase is more significant or less than the population growth rate or whether changes in the economic structure occur. Economic growth is an essential indicator for analyzing the economic development that occurs in a country. Growth is only sometimes synonymous with development. Economic growth is one of the many conditions needed (Arsyad, 2010). Kuznets (1955) defines economic growth as a long-term increase in a country's ability to provide more and more economic goods to its population; this capability grows with technological progress and the institutional and ideological adjustments it requires. Kuznets also stated that the notion of economic growth could be divided into four criteria, namely (1) an increase in consumer demand in line with an increase in income, (2) an increase in human and physical resources that is high, exceeding the growth of the workforce, (3) an increase in capacity technology due to innovations, (4) regional openness to international trade and capital flows that affect long-term economic growth (Arsyad, 2010). There are three components in economic growth, namely (1) capital accumulation, (2) population growth, and (3) technological progress. The process of sustainable economic growth is the primary condition for economic continuity. The population continues to grow, as well as economic needs, so additional income is needed every year. It can only be obtained through an increase in aggregate output (goods and services) or gross domestic product (GDP) every year; thus, in a macro sense, economic growth is an addition to GDP, which also means an increase in national income (Todaro & Smith, 2006).

Economic growth is now seen as a variable that plays a role in driving and motivating human development. Economic growth and human development are interrelated and mutually contribute to each other (Anggraini & Muta'ali, 2013). UNDP (2019) revealed that the quality of human development can improve if supported by high and balanced economic growth with equitable income distribution. Economic growth will be very effective in improving human development. Economic growth contributes to human development by increasing government revenue, which can be invested in human development. Recent empirical studies also confirm that economic growth plays a positive role in driving the Human Development Index (Rofiuddin, 2025; Yaya & Hanifa, 2025). This is supported by the results of research by Chalid & Yusuf (2014), and Mirza (2012) that economic growth has a positive influence on the human development index, so the proposed hypothesis is that economic growth has a positive effect on the HDI.
H1. It is suspected that economic growth has a positive and significant effect on the human development index of four provinces in Indonesia.

Poverty Relationship with the Human Development Index

Poverty is defined as the loss of social welfare, while the core problem of poverty is the limitations on welfare itself. Suppose poverty is defined as related to the level of welfare. In that case, poverty is an inability to meet welfare or access to resources to meet their needs. A lack of access is a person's income (Word Bank, 2020). The National Planning and Development Agency (2010) defines poverty as a condition in which a person or group of people, men, and women, cannot fulfill their fundamental rights to maintain and develop a dignified life. Basic rights consist of rights people with low incomes understand as their rights to enjoy a life with dignity and rights recognized in laws and regulations.

Poverty is a problem in development that can affect the Human Development Index. Poverty can also severely affect human development because poverty is a complex problem that stems from the purchasing power of people who cannot meet basic needs, so other needs, such as education and health, are neglected (Mirza, 2012). It shows that the gap in human development between the two has widened, and in the end, the target for the human development index set by the government has yet to be adequately realized. The research results also reveal that poverty has a negative effect on the human development index (Mirza, 2012). Poverty can also significantly impact human development because it is a complex problem rooted in people's purchasing power being unable to meet basic needs, so that other needs, such as education and health, are neglected (Mirza, 2012). Recent global empirical studies confirm that the Multidimensional Poverty Index (MPI) is a significant predictor of a country's HDI achievement, where countries with high levels of multidimensional poverty tend to have lower HDI scores (Alimoradi, Griffiths, & Alijanzadeh, 2025). This indicates that the human development gap between the two is widening, and ultimately, the human development index targets set by the government have not been adequately realized.
H2. It is suspected that poverty has a negative and significant effect on the human development index of four provinces in Indonesia.

METHODS

This research took place in Indonesia through the official website of the Central Bureau of Statistics. This research was conducted in July - December 2020. The data used are time series and cross-sections. Periodic data (time series), namely data based on the period of occurrence or from time to time, in this study used data valid for five years starting in 2015-2019. Data collection is directly obtained through the National BPS website. This data includes the human development index, economic growth, and poverty data for 2015-2019. This study uses a model of multiple regression analysis of panel data. Panel or pooled data combines time series and cross-section data (Gujarathi, 2022). The choice between the Pooled Least Square (PLS) and Fixed Effect Model (FEM) methods uses the Chow test, while the Hausman test is used to choose between the Random Effect Model (REM) or the Fixed Effect Model (FEM). The F test can be used to select techniques with Pooled Least Square (PLS) or Fixed Effect Model (FEM) models. The Hausman test is used to choose between Fixed or Random effect methods.

The Human Development Index explains how people can access development outcomes regarding income, health, education, and others. Human development index data is used in units of percent. Furthermore, economic growth data is expressed in the 2010 Gross Regional Domestic Product Growth Rate at Constant Prices in units of percent. Finally, the poverty rate data (KMS) shows the number of poor people in four provinces from 2015 to 2019.

RESULTS

The average human development index in Papua Province from 2015-2019 was 59.06%. The low value of the human development index in Papua is due to the need for the government's role in increasing community development in three areas: education, economy, and health in Papua Province, coupled with the number of poor people who are still considerable. Papua has enormous natural resources, so it should be able to compete with other provinces in Indonesia in increasing the human development index.

Table 1. Development of the Human Development Index in the Province of Indonesia in the Lower-Medium Category (Percentage Unit)

Province	2015	2016	2017	2018	2019	Average
East Nusa Tenggara	62,67	63,13	63,73	64,39	65,23	63,83
West Sulawesi	62,96	63,60	64,30	65,10	65,73	64,34

West Papua	61,73	62,21	62,99	63,74	64,70	63,07
Papua	57,25	58,05	59,09	60,06	60,84	59,06

Source: BPS (2020)

Table 1. also shows that West Papua Province has the second lowest human development index in the Province of Indonesia with the Lower-Medium category. The value of the human development index in West Papua is higher than in Papua Province. In general, the human development index in West Papua continues to increase every year. The increase in the human development index for the Province of West Papua was driven by an increase in life expectancy, expected length of schooling, and per capita expenditure in all districts/cities of West Papua Province (BPS, 2020c).

Table 2. Development of Economic Growth in Indonesian Provinces in the Low-Medium Category (Percentage Unit)

Province	**2015**	**2016**	**2017**	**2018**	**2019**	**Average**
East Nusa Tenggara	4,92	5,12	5,11	5,13	5,20	5,10
West Sulawesi	7,31	6,01	6,39	6,25	5,66	6,32
West Papua	4,15	4,52	4,02	6,25	2,66	4,32
Papua	7,35	9,14	4,64	7,37	-15,72	2,56

Source: BPS (2020)

On average, from 2015 to 2019, based on Table 2, Papua Province had the lowest economic growth. Papua Province's economic growth is the lowest because, in 2019, it grew negatively. This condition is caused by decreased production of the largest mine in Papua, which has entered the final phase of open pit mining to underground mining (PII, 2019).

Table 3. Development of the Poor Population in the Province of Indonesia in the Low-Medium Category (Thousands of People)

Province	**2015**	**2016**	**2017**	**2018**	**2019**	**Average**
East Nusa Tenggara	209,99	211,24	1134,74	1134,11	1129,46	763,91
West Sulawesi	153,21	146,90	149,47	152,83	151,87	150,86
West Papua	225,54	223,60	212,86	213,67	207,59	216,65
Papua	898,21	914,87	910,42	915,22	900,95	907,93

Source: BPS (2020)

Table 3. shows that the Province of Papua, on average, from 2015–2019, has the highest number of poor people, namely 907.93 thousand. That is due to the increase in the number of poor people in urban and rural areas (BPS, 2020d). The second highest number of poor people is in East Nusa Tenggara Province, with an average poverty rate of 763.91 thousand due to the increasing number of poor people in rural areas and the very high disparities between regions.

Table 4. Panel Data Regression Model Selection Results

PLS or FEM	**FEM or REM**

H_0: PLS H_1: FEM α = 5% Test Criteria: H_0 rejected if prob. Chow < 5% H_0 accepted if prob. Chow > 5% Conclusion: Prob. test Chow = 0,0000 So, if H_0 is rejected due to prob. test Chow (0,0000) < 5%, the FEM model is the best and selected.	H_0: REM H_1: FEM α = 5%` Test Criteria: H_0 rejected if prob. Hausman < 5% H_0 accepted if prob. Hausman > 5% Conclusion: Prob, test Hausman = 0,0030 Jadi, H_0 rejected due to prob. test Hausman (0,0030) < 5%, so the FEM model is the best and selected.

Source: Calculation results with Eviews 11

Based on the Chow and Hausman test results, the best method is the FEM method. The FEM results show that economic growth has no significant effect on the human development index in the province with the lower-medium category. In contrast, the number of poor people significantly affects the human development index in the province, with the lower-medium category.

Table 5. FEM Estimation Results

Variable	**Parameter**	**Scope**	**Estimation Models**
			FEM
Constant	Â	Coefficient	4.048
		Standard Error	0.042
		Prob.	0.000
Economic Growth	β1	Coefficient	-0.001
		Standard Error	0.000
		Prob.	0.031**
Poverty	β2	Coefficient	0.016
		Standard Error	0.007
		Prob.	0.041**

Source: Calculation results with Eviews 11

** Significance at the 1% level
* Significance at the 5% level

The regression coefficient of the variable economic growth on the human development index is -0.001 with a probability value of 0.031, which means it is smaller than the value of α (1% and 5%). The

results are in the area of rejecting H0, so this parameter cannot be used as a significant estimator and influences the dependent variable human development index. The coefficient value of -0.001 indicates a negative relationship between the two variables. The relationship between economic growth and the human development index can be interpreted if there is an increase in economic growth by 5%. The human development index will decrease by -0.001 units, assuming other variables are constant or vice versa.

The regression coefficient of the poverty variable on the human development index is 0.016 with a probability value of 0.041, which means it is smaller than the value of α (1% and 5%). The results are in the area of rejecting H0, so this parameter cannot be used as a significant estimator and can affect the dependent variable human development index.

DISCUSSION

The study results show shocking findings that economic growth has a negative and significant effect on the human development index of four provinces in Indonesia. The results of this study are different from the theory put forward by Arsyad (2010), and UNDP (2019) that the quality of human development will increase if economic growth also increases. These results also contradict the results of research conducted by Chalid and Yusuf (2014), and Mirza (2012) that there is a positive relationship between economic growth and HDI. That is due to the uneven economic growth conditions compared to the HDI, which tends to be evenly distributed in the four provinces. The provinces of East Nusa Tenggara, West Sulawesi, and West Papua have shown positive economic growth rates over the last five-year period (2015-2019), while the Papua province has had uneven economic growth because, in 2019, its economic growth was corrected very deeply, namely -15.72 %.

The research results for the second hypothesis also provide surprising findings that poverty positively impacts HDI. These results also fail to confirm the theory presented by the World Bank (2020) and the National Planning and Development Agency (2010) that poverty means loss of social welfare due to a person's lack of income, which seriously impacts HDI. This result must also align with the research results presented by Mirza (2012), who found a negative relationship between poverty and HDI. The inconsistent relationship is the uneven distribution of the poor population in the four provinces. In addition, the HDI value is in the low category, so the relationship between the two will remain positive.

CONCLUSION

The findings of this study reveal counterintuitive results that challenge the conventional paradigm in development economics. Economic growth actually showed a significant negative impact on the Human Development Index (HDI) in four low-HDI provinces in Indonesia, while poverty had a significant positive correlation. Theoretically, these findings enrich the discourse on the non-linear relationship between economic growth and human development, indicating that in disadvantaged regions, economic growth may be exclusive or not yet in favor of improving the quality of life of the community, such as investment being more concentrated in capital-intensive and labor-intensive sectors. Conversely, the positive relationship between poverty and the HDI can be explained by well-targeted government interventions, where social protection programs and direct assistance to the poor can improve their access to basic education and healthcare, even though aggregate incomes remain low.

The practical implications of this study emphasize that economic growth policies in disadvantaged regions cannot stand alone but must be integrated with pro-poor growth strategies and increased public spending in the basic services sector. Policymakers in these four provinces need to re-evaluate the quality of economic growth to ensure that economic expansion truly translates into improved health, education, and a decent standard of living. Based on the finding that economic growth actually has a negative impact

on the Human Development Index (HDI) in low-status provinces, local governments need to conduct an in-depth evaluation of the quality of economic growth by ensuring that investment and economic expansion are directed toward sectors that directly impact health, education, and public purchasing power. Given that poverty has been shown to have a positive impact on the HDI, existing poverty alleviation strategies, such as social assistance and community protection programs, need to be continuously strengthened and integrated with policies to increase access to basic services to optimize their effectiveness in promoting human development. Furthermore, the central and local governments need to design policies that simultaneously promote inclusive economic growth and expand the reach of poverty reduction programs, as these two variables have been shown to have complex dynamics that mutually influence human development achievements in disadvantaged regions.However, this study suffers from major limitations, including the use of provincial-level aggregate data, which fails to capture disparities between districts/cities, and the absence of control variables such as governance quality, local government spending, or demographic characteristics. Therefore, future research is recommended to measure economic growth based on sectoral analysis to identify which sectors contribute most to the HDI, and to expand the analysis to the district/city level by considering multidimensional poverty indicators and institutional variables to generate more precise and contextual policy recommendations.

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