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Interactions of Digitalisation and Sustainable Finance in Shaping Profitability of Indonesian State Banks

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ABSTRACT

Purpose: This study examines the determinants of financial performance in Indonesian state-owned and regionally owned banks by integrating prudential indicators with developmental, sustainability, and digital transformation variables. It evaluates how digital capability and green lending moderate the effects of credit risk, earning power, and developmental credit on profitability.

Method: The analysis uses balanced panel data from six banks over two thousand nineteen to two thousand twenty-three. A fixed effect panel regression model with interaction terms captures both direct determinants and moderating influences. Key predictors include nonperforming loans, net interest margin, developmental credit, and cooperative or village enterprise lending, while moderating variables comprise digital capability and green lending.

Findings: Nonperforming loans exert the strongest negative effect on profitability, whereas net interest margin remains the primary driver of return on assets. Developmental credit and lending to local enterprises enhance financial performance. Green lending and environmental, social, and governance performance are positively associated with profitability. Digital capability weakens the adverse influence of credit risk and strengthens the gains from earning power. Green lending amplifies the positive effect of developmental credit.

Implications: Profitability in state-aligned banks reflects the combined influence of prudential fundamentals, developmental mandates, sustainable finance initiatives, and digital transformation. Strengthening credit risk management, improving developmental programme mechanisms, expanding green finance, and deepening digital capability are essential for enhancing performance and informing regulatory incentive design.

Novelty/Value: This study offers integrated empirical evidence on prudential, developmental, sustainability, and digital determinants of profitability in Indonesian state banking. It demonstrates that digital capability and green lending not only improve financial outcomes but also reinforce the effectiveness of developmental credit, thereby advancing research on development-oriented and sustainable finance models.

Keywords: bank performance; digital capability; developmental credit; sustainable finance; state-owned banks.

INTRODUCTION

The banking sector plays a central role in promoting financial stability and supporting national economic development through its functions in payment facilitation, liquidity transformation, and credit intermediation. In emerging economies such as Indonesia, banks serve as the primary channel for productive sector financing and remain critical to sustaining macroeconomic resilience (Aninwagu & Onyema, 2025; Chung et al., 2010). Recent reports from the Financial Services Authority show that Indonesian banks have maintained sound capital positions and solid liquidity buffers during periods of global uncertainty, suggesting effective implementation of prudential risk management practices (Hastuti & Santoso, 2025). Within this system, state-owned banks and regionally owned banks hold a distinctive institutional position because they are required to meet commercial objectives while simultaneously supporting national development agendas, including the empowerment of microenterprises, strengthening of cooperatives, and improvement of local economic capacity (Tajuddin & Kessi, 2025).

During the past decade, Indonesian banking has experienced substantial transformation driven by technological innovation, regulatory reforms, and a strengthened sustainability agenda (Nurwulandari et al., 2022). State banks in particular have demonstrated strong performance while expanding developmental lending through government supported programmes such as *Kredit Usaha Rakyat*, which contributes significantly to micro and small enterprise financing. At the same time, the spread of artificial intelligence, digital ecosystems, and data driven financial services has accelerated the transition toward a more technologically intensive banking model, often described as the Bank 5.0 paradigm (Kardiman et al., 2025). This digital shift enhances operational efficiency and improves risk detection capabilities but also introduces new forms of competition from financial technology firms and exposes banks to cyber related vulnerabilities (Jović & Nikolić, 2022). These trends imply that bank performance is increasingly shaped by a combination of traditional prudential indicators and technologically enabled capabilities.

Recent Indonesian studies provide evidence that digitalisation exerts an important influence on banking performance. Research shows that digital service expansion enhances profitability by improving cost efficiency, strengthening credit appraisal accuracy, reducing processing times, and increasing transaction volume (Kardiman et al., 2025). Other findings reveal that digital transformation supports higher financial stability through improved monitoring, early warning systems, and enhanced customer retention in digital channels (Kusuma et al., 2024). Empirical work on Indonesian commercial banks also shows that digital capability increases fee based income and improves the quality of intermediation (Ferli et al., 2022; H.-B. Ong et al., 2023). However, prior studies generally analyse digitalisation as a direct determinant of performance and do not investigate whether technological capability moderates the impact of traditional factors such as credit risk and net interest margin, especially in state aligned banks that manage extensive developmental credit portfolios (Podder & Ghosh, 2025; Wang et al., 2022).

Parallel to technological change, the rise of sustainable finance has added a new dimension to bank performance evaluation in Indonesia. The national sustainable finance roadmap requires banks to expand green lending and strengthen environmental, social, and governance disclosures. Indonesian evidence indicates that banks with higher proportions of green credit portfolios tend to achieve stronger profitability and lower long term credit risk, particularly in renewable energy, environmental infrastructure, and climate related sectors (Nurfitriani & Latif, 2025; Sutrisno et al., 2024). Studies also show that stronger environmental, social, and governance practices enhance stakeholder trust and reputational value, which contribute positively to return on assets (Handoyo & Anas, 2024; Sulfiana, 2025). Despite these insights, most Indonesian research examines green lending or environmental, social, and governance performance in isolation and does not explore how sustainable finance interacts with developmental credit orientation, which is a defining feature of state-owned and regionally owned banks.

Although extensive studies have analysed the effects of capital adequacy, liquidity, credit risk, interest margins, and operational efficiency on bank profitability in Indonesia, these works rely largely on conventional indicators and overlook the structural shifts that have reshaped the business models of

state-owned financial institutions. The literature does not provide an integrated explanation of how developmental lending, digital capability, green lending, and government liquidity support jointly influence financial outcomes. Furthermore, no empirical study has examined whether digital capability weakens the negative effects of credit risk or strengthens the profitability gains from intermediation margins. Likewise, the performance implications of the interaction between developmental credit and green lending have not been tested, even though both elements are central to current policy directions.

These gaps demonstrate that traditional models of profitability are insufficient for explaining performance in Indonesian state-owned and regionally owned banks, which operate under a hybrid mandate combining prudential discipline, developmental objectives, technological innovation, and sustainability commitments. A comprehensive and contemporary empirical framework is therefore required to capture the combined influence of these factors and to understand how they interact in shaping financial outcomes.

This study responds to these gaps by developing a moderated performance model that integrates classical banking fundamentals, developmental credit orientation, cooperative and village enterprise lending, green lending intensity, environmental and social performance, digital capability, and government liquidity support. The model investigates whether digital capability moderates the impact of nonperforming loans and net interest margin on profitability, and whether green lending strengthens the financial effects of developmental credit. By employing balanced panel data from two thousand nineteen to two thousand twenty-three, this study provides an updated and contextually grounded understanding of the determinants of financial performance in Indonesian state-owned and regionally owned banks.

LITERATURE REVIEW

Theoretical Foundation

The analysis of bank profitability in this study is grounded in an integrated theoretical framework that combines financial intermediation theory, risk management theory, development banking theory, and the resource-based view of the firm. These complementary perspectives are required to explain the behaviour of state-owned and regionally owned banks, which operate under hybrid mandates that differ substantially from purely profit oriented commercial banks.

Financial intermediation theory provides the core foundation for understanding bank profitability (Konstantakopoulou, 2023). Banks exist to reduce transaction costs and information asymmetry between savers and borrowers by transforming deposits into productive loans. Profitability emerges from the efficiency of this transformation process, particularly through interest margins, loan allocation, and asset utilisation. In bank based financial systems such as Indonesia, intermediation activities remain the dominant source of income, making variables such as loan to deposit ratio and net interest margin central determinants of return on assets (Saleh & Abu Afifa, 2020; Wasiaturrahma, Sulistyowati, et al., 2020). Recent empirical evidence from emerging economies confirms that effective intermediation continues to be a primary driver of banking performance where capital markets are less developed (Bernard Azolibe, 2022).

Risk management theory complements the intermediation perspective by emphasising the role of asset quality and capital buffers in sustaining profitability. Credit risk, commonly proxied by nonperforming loans, directly erodes earnings through higher provisioning requirements and foregone interest income. Capital adequacy reflects a bank capacity to absorb unexpected losses and maintain solvency during periods of financial stress. Empirical studies consistently show that higher nonperforming loans weaken profitability, while adequate capital buffers support financial resilience, particularly in emerging market banking systems characterised by higher borrower vulnerability (Nurwulandari et al., 2022; Rahmania et al., 2024). From this perspective, profitability is inseparable from effective risk containment and prudential discipline.

Development banking theory is essential for explaining the performance dynamics of state-owned and regionally owned banks. Unlike private commercial banks, these institutions are mandated to support national and regional development objectives through targeted lending to micro and small

enterprises, cooperatives, and priority sectors. Traditional public banking literature often associates developmental mandates with inefficiency due to political interference and soft budget constraints. However, more recent development finance studies demonstrate that developmental credit can be financially sustainable when supported by institutional mechanisms such as credit guarantees, programme targeting, and regulatory oversight (Kanga et al., 2024). Evidence from Indonesia shows that structured developmental programmes such as microenterprise and priority sector lending can contribute positively to bank profitability when aligned with risk sharing schemes and monitoring systems (Adam et al., 2025; Junarsin et al., 2023). In this framework, developmental credit orientation is treated not as a distortion but as a structural characteristic of state banking business models.

The resource-based view of the firm further extends the theoretical foundation by highlighting the role of internal capabilities in shaping financial performance. According to this perspective, sustainable competitive advantage arises from valuable, rare, and difficult to imitate organizational resources. Digital capability represents an intangible strategic resource that enhances a bank ability to process information, manage risk, and deliver services efficiently. Recent studies show that digital transformation improves operational efficiency, credit screening accuracy, and transaction-based income generation in banking institutions (Ferli et al., 2022; Podder & Ghosh, 2025). Importantly, digital capability does not merely affect profitability directly but conditions how traditional intermediation and risk variables translate into financial outcomes by strengthening monitoring precision and pricing effectiveness (Wang et al., 2022).

Sustainable finance theory provides an additional layer of explanation for the inclusion of green lending and environmental, social, and governance performance. This perspective argues that financial institutions increasingly internalise environmental and social considerations due to regulatory pressure, stakeholder expectations, and long-term risk management concerns. Empirical banking studies show that green lending and stronger environmental, social, and governance performance are associated with improved profitability, lower long run credit risk, and enhanced reputational capital (Handoyo & Anas, 2024; Sutrisno et al., 2024) In development-oriented banks, sustainability commitments interact with developmental mandates by aligning financial inclusion objectives with environmental responsibility, thereby reshaping the profitability implications of priority sector lending (Nurfitriani & Latif, 2025).
Together, these theoretical perspectives provide a coherent foundation for an integrated profitability model in which prudential fundamentals, developmental credit orientation, digital capability, and sustainable finance jointly determine financial performance. This framework supports the inclusion of moderation effects by recognising that organizational capabilities and sustainability aligned lending practices condition the impact of traditional banking determinants on profitability, rather than operating as isolated drivers. The conceptual relationships derived from these theories are synthesised and illustrated in the research framework presented in Figure 1.

Capital Adequacy Ratio and Profitability

Capital adequacy ratio reflects a bank's capacity to absorb unexpected losses and maintain solvency while sustaining its intermediation function (Linggadjaya et al., 2025). From the perspective of risk management theory, higher capital buffers reduce the likelihood of financial distress and enhance confidence among regulators, depositors, and investors (Nocco & Stulz, 2022). Adequate capital also provides flexibility for productive asset allocation, particularly in emerging economies characterised by higher borrower risk. While empirical findings on the profitability effects of capital adequacy are mixed, development oriented banking literature suggests that capital strength supports sustainable profitability when regulatory frameworks encourage effective asset deployment rather than capital hoarding (Bernard Azolibe, 2022; Kanga et al., 2024; Saleh & Abu Afifa, 2020). Accordingly, capital adequacy is theoretically expected to contribute positively to bank profitability. Based on this reasoning, the following hypothesis is proposed.
H1: Capital adequacy ratio has a positive effect on bank profitability.

Loan to Deposit Ratio and Profitability

Loan to deposit ratio captures the extent to which banks transform collected deposits into earning assets and reflects the effectiveness of financial intermediation (Alfhaili, 2025). Financial intermediation theory suggests that profitability increases when deposits are efficiently allocated into productive loans

that generate interest income (Konstantakopoulou, 2023). In bank based financial systems such as Indonesia, where lending activities dominate income generation, loan expansion represents a central channel through which banks sustain profitability (Bernard Azolibe, 2022; Wasiaturrahma, Sulistyowati, et al., 2020). While excessively high loan to deposit ratios may increase liquidity risk, an optimal level of intermediation is theoretically expected to enhance return on assets by improving fund utilisation. Accordingly, loan to deposit ratio is expected to have a positive effect on bank profitability. Based on this reasoning, the following hypothesis is formulated.

H2: Loan to deposit ratio has a positive effect on bank profitability.

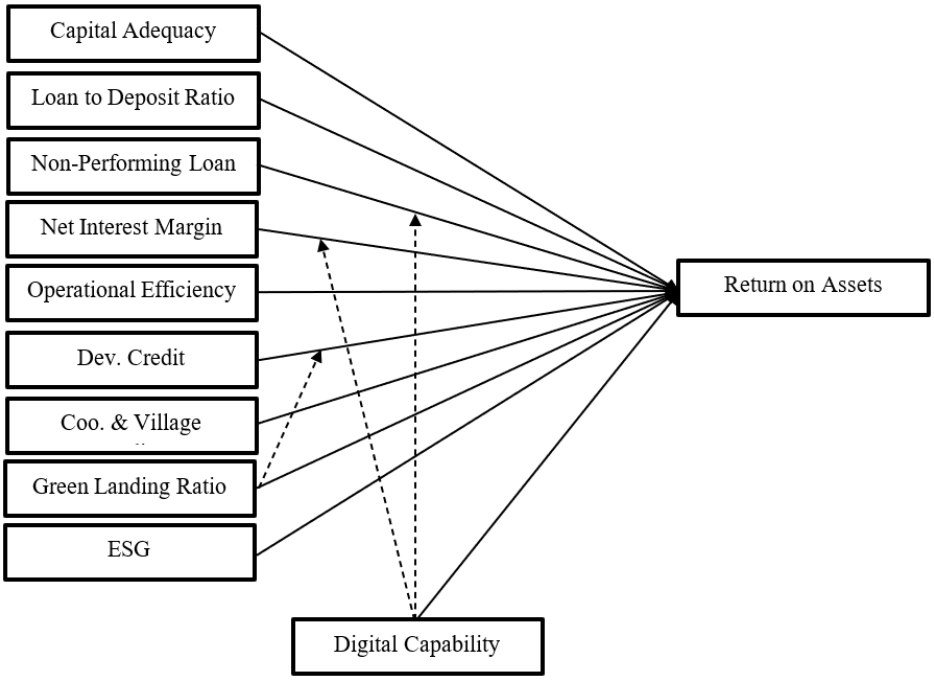

Figure 1. Research Framework

Credit Risk and Profitability

Credit risk refers to the likelihood that borrowers will fail to meet their contractual repayment obligations, thereby exposing banks to income loss and capital erosion (Ngo & Trinh, 2025). In banking research, credit risk is commonly proxied by the nonperforming loan ratio, which captures the deterioration of loan quality (Naili & Lahrichi, 2022). From the perspective of risk management theory, higher levels of nonperforming loans are expected to undermine profitability by increasing provisioning requirements, reducing effective interest income, and diverting managerial resources toward recovery activities. These effects are particularly salient in emerging economies characterised by higher borrower vulnerability and informational asymmetry (Nurwulandari et al., 2022; Rahmania et al., 2024). Accordingly, credit risk is theoretically expected to exert a negative effect on bank profitability. Based on this reasoning, the following hypothesis is proposed.

H3: Nonperforming loans have a negative effect on bank profitability.

Net Interest Margin and Profitability

Net interest margin reflects the spread between interest income from lending activities and interest expenses on funding sources and represents the core earnings mechanism in interest based banking systems (Abdeljawad et al., 2025). Within the framework of financial intermediation theory, profitability arises from the effective pricing of credit risk and efficient transformation of deposits into earning assets. In emerging market contexts such as Indonesia, where fee based income remains relatively limited, net interest margin continues to play a central role in determining bank profitability. (Bernard Azolibe, 2022; Wasiaturrahma, Sulistyowati, et al., 2020). Accordingly, higher net interest

margins are theoretically expected to enhance return on assets through increased income per unit of earning assets. Based on this reasoning, the following hypothesis is proposed.
H4: Net interest margin has a positive effect on bank profitability.

Operational Efficiency and Profitability

Operational efficiency reflects a bank's ability to generate income while controlling operating costs and is commonly proxied by the ratio of operating expenses to operating income. Efficiency theory posits that banks with lower cost burdens relative to income are able to retain a greater share of revenues as profit, thereby strengthening financial performance (Dinka & Asfaw, 2026). Higher operational efficiency enhances competitiveness by allowing banks to allocate resources more effectively toward lending activities, technological investment, and service improvement. Conversely, inefficiency signals structural rigidities and excessive administrative costs that weaken profitability (Nurwulandari et al., 2022). Accordingly, operational efficiency is expected to be a key determinant of bank profitability, particularly in development oriented financial institutions. Based on this reasoning, the following hypothesis is proposed.
H5: Operational inefficiency negatively affects bank profitability.

Developmental Credit Orientation and Profitability

Developmental credit orientation reflects the extent to which banks allocate their loan portfolios toward policy driven sectors such as micro and small enterprises, priority industries, and government supported development programmes (Li et al., 2025). From the perspective of development banking theory, state-owned and regionally owned banks are established to address market failures in credit allocation by extending financing to segments underserved by private financial institutions (Loizos, 2023). Although traditional public banking literature associates such mandates with inefficiency and political intervention, more recent development finance scholarship argues that developmental lending can be financially sustainable when supported by institutional arrangements such as credit guarantees, targeted programmes, and structured monitoring mechanisms that mitigate risk exposure (Kanga et al., 2024). Under these conditions, developmental credit orientation is theoretically expected to support bank profitability by expanding lending activity while maintaining manageable risk levels. Based on this reasoning, the following hypothesis is proposed.
H6: Developmental credit orientation has a positive effect on bank profitability.

Cooperative and Village Lending and Profitability

Cooperative and village enterprise lending represents a form of locally embedded finance that supports community based economic activities and rural development (Mitzinneck et al., 2024). Relationship banking theory suggests that lending to cooperatives and village enterprises reduces information asymmetry through repeated interactions and collective accountability, thereby lowering default risk and supporting stable credit relationships. For state-owned and regionally owned banks, such lending aligns with regional development mandates and long term intermediation objectives (Wasiaturrahma, Sulistyowati, et al., 2020). When supported by appropriate governance mechanisms, cooperative and village lending is theoretically expected to generate stable income streams and contribute positively to bank profitability (Junarsin et al., 2023). Accordingly, the following hypothesis is formulated.
H7: Cooperative and village lending positively affect bank profitability.

Green Lending and Profitability

Green lending refers to the allocation of bank credit toward environmentally sustainable activities such as renewable energy, energy efficiency, sustainable agriculture, and climate resilient infrastructure (Rahman et al., 2023). Sustainable finance theory argues that environmentally aligned lending enhances bank performance by improving portfolio quality, reducing long term environmental and regulatory risk, and strengthening compliance with sustainability frameworks (Mouti et al., 2025). In emerging economies, national sustainable finance roadmaps encourage banks to integrate environmental considerations into credit allocation, thereby supporting more stable returns from lower risk projects (Sutrisno et al., 2024). When supported by regulatory incentives and policy frameworks, green lending

is therefore theoretically expected to contribute positively to bank profitability (Handoyo & Anas, 2024; Nurfitriani & Latif, 2025). Based on this reasoning, the following hypothesis is proposed.
H8: Green lending has a positive effect on bank profitability.

Environmental, Social, and Governance Performance and Profitability

Environmental, social, and governance performance reflects the quality of a bank's governance practices, social responsibility, and environmental risk management. From the perspective of signalling theory, strong environmental, social, and governance performance conveys credible information regarding a bank's long term orientation, risk management quality, and ethical standards, thereby strengthening stakeholder trust and institutional legitimacy (Handoyo & Anas, 2024). In the banking sector, environmental, social, and governance practices are also increasingly embedded in regulatory and supervisory frameworks. By enhancing reputational capital and mitigating long term environmental and social risks, stronger environmental, social, and governance performance is theoretically expected to support improved financial outcomes (Nurfitriani & Latif, 2025; Rahmania et al., 2024). Accordingly, banks with higher environmental, social, and governance performance are expected to achieve greater profitability. Based on this reasoning, the following hypothesis is formulated.
H9: Environmental, social, and governance performance positively affects bank profitability.

Digital Capability and Profitability

Digital capability refers to a bank's ability to deploy digital technologies to support service delivery, transaction processing, credit assessment, and risk monitoring. From the resource based view, digital capability constitutes an intangible strategic asset that enhances operational efficiency and strengthens competitive advantage. In the banking sector, digital transformation enables process automation, reduces transaction costs, and improves the accuracy of credit evaluation, which is particularly valuable in emerging economies characterised by large and geographically dispersed borrower bases (Ferli et al., 2022; Podder & Ghosh, 2025). By improving efficiency, scalability, and revenue conversion, digital capability is theoretically expected to contribute positively to bank profitability (Ong et al., 2023; Kardiman et al., 2025). Based on this reasoning, the following hypothesis is proposed.
H10: Digital capability has a positive effect on bank profitability.

Government Liquidity Support and Profitability

Government liquidity support refers to the placement of public funds or liquidity injections by the state to strengthen the lending capacity and financial stability of state-owned and regionally owned banks. From a development finance perspective, such support functions as a policy instrument designed to ensure that banks have sufficient funding to fulfil developmental mandates without undermining prudential stability (Indrawati & Kuncoro, 2021). Development banking and financial stability theories argue that well designed liquidity placements can ease funding constraints, reduce liquidity risk, and stabilise intermediation activity, particularly in banks tasked with policy oriented lending (Bui et al., 2020; Pape, 2022). When deployed under regulatory oversight, government liquidity support is therefore expected to enhance bank profitability by expanding loanable funds while preserving financial discipline. Based on this reasoning, the following hypothesis is formulated.
H11: Government liquidity support has a positive effect on bank profitability.

Digital Capability as a Moderator of Credit Risk

Digital capability refers to a bank's ability to deploy digital technologies to support service delivery, transaction processing, credit assessment, and risk monitoring. From the resource based view, digital capability constitutes an intangible strategic asset that enhances operational efficiency and strengthens competitive advantage. In banking, digital transformation enables process automation, reduces transaction costs, and improves credit evaluation accuracy, which is particularly valuable in emerging economies characterised by large and geographically dispersed borrower bases (Ferli et al., 2022; Podder & Ghosh, 2025). By improving efficiency and scalability in intermediation activities, digital capability is theoretically expected to contribute positively to bank profitability (Kardiman et al., 2025; Ong et al., 2021). Based on this reasoning, the following hypothesis is proposed.

H12: Digital capability weakens the negative effect of nonperforming loans on bank profitability.

Digital Capability as a Moderator of Earning Power

Digital capability enhances a bank's ability to translate earning power into realised profitability by strengthening pricing accuracy, reducing marginal service delivery costs, and improving customer retention through digital channels. From an intermediation perspective, digital technologies support more effective risk based pricing and operational scalability, thereby reinforcing the transmission of net interest margins into financial performance (Ferli et al., 2022; H.-B. Ong et al., 2023). Consistent with the resource based view of the firm (Podder & Ghosh, 2025), digital capability functions as an organisational capability that conditions how traditional revenue drivers affect profitability. Accordingly, higher digital capability is theoretically expected to strengthen the positive relationship between net interest margin and bank profitability. Based on this reasoning, the following hypothesis is formulated.

H13: Digital capability strengthens the positive effect of net interest margin on bank profitability.

Moderating Role of Green Lending in Developmental Credit

Green lending is expected to condition the profitability of developmental credit by shaping portfolio composition and risk characteristics. From the perspective of development banking theory, the financial outcomes of developmental lending depend not only on lending volume but also on the sectors to which credit is allocated. When developmental credit is aligned with environmentally sustainable activities, banks may benefit from lower long term risk exposure and regulatory incentives. Sustainable finance theory further suggests that environmentally aligned lending improves credit quality and resilience, thereby strengthening financial returns from policy oriented lending (Nurfitriani & Latif, 2025; Sutrisno et al., 2024). Accordingly, green lending is theoretically expected to enhance the positive effect of developmental credit orientation on bank profitability. Based on this reasoning, the following hypothesis is proposed.

H14: Green lending strengthens the positive effect of developmental credit orientation on bank profitability.

RESEARCH METHOD

This study employs a quantitative explanatory research design to analyse the determinants of financial performance in Indonesian state-owned and regionally owned banks, with a particular focus on how digital capability and sustainability-oriented lending moderate the effects of traditional banking indicators. The objective is to identify the causal influence of prudential fundamentals, developmental credit orientation, sustainable finance commitment, digital transformation, and state liquidity support on bank profitability. To achieve this objective, the study uses longitudinal secondary data and applies panel data econometric techniques that are suitable for modelling unobserved heterogeneity across banks and structural changes over time. The dependent variable, independent variables, moderating variables, and their operational definitions are summarised in Table 1.

The population of the study consists of all forty-seven commercial banks listed on the Indonesia Stock Exchange during the period 2019 to 2023. Because the research focuses on the dual commercial and developmental mandate of state-owned financial institutions, purposive sampling was used to select banks that meet two criteria. First, the bank must be a State-Owned Enterprise or a Regionally Owned Enterprise. Second, the bank must consistently publish complete financial statements, sustainability reports where applicable, and digital service disclosures during the observation period. Based on these criteria, six banks were selected. With five years of observations for each bank, the final balanced panel consists of thirty bank year observations.

Table 1. Variables and Operational Definitions

Variable	Conceptual Definition	Operational Definition/ Measurement	Source
Dependent			
Return on Assets (ROA)	Bank profitability reflecting the efficiency of asset utilisation	Net income divided by total assets	Annual report; IDX
Independent			
Capital Adequacy Ratio (CAR)	Bank ability to absorb losses and maintain solvency	Equity capital divided by risk-weighted assets	OJK; Annual report
Loan to Deposit Ratio (LDR)	Degree of intermediation capacity through channeling deposits into loans	Total loans divided by third-party funds	Annual report
Nonperforming Loans (NPL)	Level of credit risk reflected in the proportion of problematic loans	Nonperforming loans divided by total loans	OJK; Annual report
Net Interest Margin (NIM)	Earning capacity from interest-based intermediation activities	Net interest income divided by average earning assets	Annual report
Operational Efficiency (BOPO)	Bank ability to control operating costs relative to income	Operating expenses divided by operating income	Annual report
Developmental Credit Orientation (DCO)	Degree of bank alignment with state developmental mandates in lending	Share of micro, small, KUR, or priority sector loans divided by total loans	Sustainability report; Annual report
Cooperative and Village Lending (CVL)	Extent of lending to cooperatives and village enterprises in support of local development	Cooperative and village programme loans divided by total loans	OJK; Bank disclosure
Green Lending Ratio (GLR)	Bank commitment to sustainable finance through environmentally aligned lending	Loans classified as green under OJK taxonomy divided by total loans	Sustainability report; OJK
ESG Performance Index (ESG)	Bank environmental, social, and governance disclosure quality	Composite ESG disclosure score extracted from sustainability reports	Sustainability report
Digital Capability Index (DIG)	Bank digital transformation capability supporting efficiency, risk control, and service innovation	Composite index of digital transactions share, digital service user share, and digital investment intensity	Annual report; Bank digital disclosures
Government Liquidity Support (GLS)	Extent of state liquidity placement intended to strengthen lending capacity	Total government deposits or liquidity placements divided by total deposits	Ministry of Finance; OJK
Moderation			
NPL × DIG	Effect of digital capability in conditioning the impact of credit risk on performance	Product of NPL and DIG values	Computed
NIM × DIG	Effect of digital capability in strengthening earning power from intermediation	Product of NIM and DIG values	Computed
DCO × GLR	Extent to which sustainable lending influences the effect of developmental lending on performance	Product of DCO and GLR values	Computed

Source: Previous Research

The inclusion of digitalisation and sustainability variables in this study reflects the structural complexity of the contemporary Indonesian banking industry. Unlike firms in other sectors, banks

operate within a tightly regulated financial architecture where technological capability and sustainability compliance directly affect risk management processes, asset quality, and intermediation performance. Digital capability is therefore incorporated as a multidimensional construct capturing the breadth of a bank capacity to deploy digital transactions, automate credit evaluation, enhance monitoring precision, and improve service delivery. These functions are critical because digitalisation interacts with prudential determinants by influencing credit risk exposure and earnings transmission mechanisms.

Likewise, sustainability variables such as green lending and environmental and social governance performance are included to reflect policy driven complexity. Indonesian banks are subject to the national sustainable finance roadmap, which mandates the integration of environmentally aligned lending and environmental and social risk assessments. These sustainability commitments influence portfolio composition, long term credit risk, and reputational capital. The inclusion of these variables therefore allows the model to capture the complex regulatory, technological, and policy environment within which state-owned and regionally owned banks operate, ensuring that the empirical framework reflects the distinctive nature of banking compared with other industries.

All data were extracted from audited annual reports, financial statements published on the Indonesia Stock Exchange, sustainability reports, and official disclosures submitted to the Financial Services Authority. Additional information on green lending and digital service indicators was obtained from sustainability disclosures, ESG summary reports, and bank digital transformation statements. Government liquidity placement data were collected from official releases by the Ministry of Finance and *Otoritas Jasa Keuangan*.

Baseline Model:

$$\begin{aligned} ROA_{it} &= \alpha + \beta_1 CAR_{it} + \beta_2 LDR_{it} + \beta_3 NPL_{it} + \beta_4 NIM_{it} + \beta_5 BOPO_{it} \\ &+\beta_6 DCO_{it} + \beta_7 CVL_{it} + \beta_8 GLR_{it} + \beta_9 ESG_{it} + \beta_{10} DIG_{it} + \beta_{11} GLS_{it} \\ &+\mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \quad (1)$$

Moderation Model:

$$\begin{aligned} ROA_{it} &= \alpha + \mathrm{X}'_{it}\beta + \mathrm{Z}'_{it}\theta \\ &+\delta_1(NPL_{it} \times DIG_{it}) + \delta_2(NIM_{it} \times DIG_{it}) + \delta_3(DCO_{it} \times GLR_{it}) \\ &+\mu_i + \lambda_t + \varepsilon_{it} \end{aligned} \quad (2)$$

Legend:
$\mu_i$captures unobserved bank specific effects
$\lambda_t$captures year effects
$\varepsilon_{it}$is the idiosyncratic error term.

Panel data estimation was performed using EViews 12. Three diagnostic tests were conducted to determine the appropriate estimator. First, the Chow test was used to test the fixed effect model against the pooled ordinary least squares model. Second, the Hausman specification test was used to compare the fixed effect estimator with the random effect estimator. Third, the Lagrange Multiplier test was applied to assess whether random effects outperform pooled estimates. Based on these tests, the fixed effect model was selected because it accounts for unobserved heterogeneity across banks, which is theoretically relevant given differences in ownership structure, governance, and developmental mandates.

Classical assumptions were assessed through tests for heteroskedasticity, autocorrelation, multicollinearity, and cross-sectional dependence. Variance inflation factors were calculated to ensure that multicollinearity did not distort coefficient estimates. The modified Wald test and Wooldridge test were used to detect heteroskedasticity and autocorrelation respectively. Where necessary, robust standard errors were applied.

RESULTS AND DISCUSSION

Results

Descriptive Statistics

The descriptive statistics presented in Table 2 provide an overview of the financial condition of BUMN and BUMD banks over the period 2019 to 2023. The average capital adequacy ratio of 19.5 percent indicates that these banks maintain capital levels well above the regulatory minimum of 8 percent, reflecting a strong solvency position. Nevertheless, variation across banks is evident, with some institutions reporting capital ratios closer to 14 percent, suggesting heterogeneity in capital management practices.

Table 2. Descriptive Statistics of Research Variables (2019–2023)

Variable	N	Mean	Std. Dev.	Min	Max
Return on Assets (ROA)	30	0.021	0.006	0.010	0.035
Capital Adequacy Ratio (CAR)	30	0.195	0.031	0.142	0.247
Loan to Deposit Ratio (LDR)	30	0.843	0.068	0.725	0.954
Nonperforming Loans (NPL)	30	0.027	0.009	0.015	0.048
Net Interest Margin (NIM)	30	0.048	0.007	0.032	0.061
Operational Efficiency (BOPO)	30	0.786	0.035	0.720	0.852
Developmental Credit Orientation (DCO)	30	0.312	0.081	0.180	0.455
Cooperative and Village Lending (CVL)	30	0.067	0.023	0.030	0.112
Green Lending Ratio (GLR)	30	0.092	0.041	0.020	0.165
ESG Performance Index (ESG)	30	0.644	0.108	0.410	0.810
Digital Capability Index (DIG)	30	0.528	0.121	0.310	0.750
Government Liquidity Support (GLS)	30	0.124	0.057	0.020	0.230
Interaction Term NPL × DIG	30	0.014	0.006	0.005	0.028
Interaction Term NIM × DIG	30	0.024	0.008	0.012	0.041
Interaction Term DCO × GLR	30	0.030	0.016	0.006	0.062

Source: Data Processed - 2025

The average LDR of 84.3 percent shows that loan disbursement is within the optimal liquidity range, balancing profitability and liquidity. Minimum and maximum values (72.5 percent to 95.4 percent) reveal differences in lending aggressiveness, where some banks remain conservative while others approach the upper liquidity threshold.

Correlation Analysis

Return on assets in Table 3 exhibits positive associations with net interest margin, digital capability, developmental credit orientation, and environmental, social, and governance performance. These relationships indicate that earning power, technological capacity, and sustainability commitments are positively aligned with bank profitability. In contrast, the negative correlation between return on assets and nonperforming loans confirms that credit risk remains one of the primary threats to financial performance.

Capital adequacy and loan-to-deposit ratio display moderate positive correlations with profitability and developmental lending, indicating that stronger balance sheets and active intermediation support lending to priority sectors. Nonperforming loans exhibit positive correlation with operational inefficiency, showing that deteriorating asset quality is often associated with higher cost burdens.

Digital capability correlates positively with most performance-oriented variables and negatively with nonperforming loans and operational inefficiency, reflecting the potential of technological capacity to strengthen risk control and operational effectiveness. Green lending and ESG performance show moderate positive correlations with developmental credit orientation, consistent with Indonesia sustainable finance roadmap that encourages banks to channel funds toward environmentally aligned sectors.

Table 3. Correlation Matrix of Research Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1	1.000											
2	0.241	1.000										
3	0.318	0.195	1.000									
4	-0.462	-0.382	0.281	1.000								
5	0.511	0.267	0.214	-0.318	1.000							
6	-0.478	-0.221	-0.334	0.395	-0.411	1.000						
7	0.356	0.144	0.322	-0.204	0.266	-0.295	1.000					
8	0.214	0.101	0.287	-0.177	0.203	-0.246	0.411	1.000				
9	0.298	0.172	0.166	-0.156	0.187	-0.203	0.288	0.221	1.000			
10	0.331	0.189	0.155	-0.221	0.214	-0.232	0.332	0.266	0.372	1.000		
11	0.429	0.216	0.309	-0.349	0.372	-0.319	0.367	0.309	0.245	0.311	1.000	
12	0.188	0.258	0.131	0.109	0.141	0.162	0.298	0.244	0.191	0.204	0.221	1.000

Note: ROA=1, CAR=2, LDR=3, NPL=4, NIM=5, BOPO=6, DCO=7, CVL=8, GLR=9, ESG=10, DIG=11, GLS=12

Source: Data Processed – 2025

No correlation coefficient exceeds the commonly accepted threshold of 0.70, indicating that multicollinearity is unlikely to distort the subsequent regression estimates. These correlations provide an initial indication of the relationships that are further examined in the panel regression analysis.

Panel Diagnostics

The Chow Test in Table 4 produces a highly significant probability value, indicating that the pooled ordinary least squares model is inappropriate and that the Fixed Effect Model provides a better fit for the data. This result suggests that unobserved bank specific characteristics influence profitability and must be controlled for in the estimation.

Table 4. Panel Data Diagnostic Tests

Test	Null Hypothesis	Test Statistic	Probability
Chow Test	Pooled OLS is adequate compared to Fixed Effect Model	28.374	0.0000
Hausman Test	Random Effect Model is consistent compared to Fixed Effect Model	16.842	0.0210
Lagrange Multiplier (LM) Test	Pooled OLS is adequate compared to Random Effect Model	12.117	0.0005

Source: Data Processed – 2025

The Hausman Test also yields a significant value, implying that the Random Effect estimator is inconsistent (see Table 4). Therefore, the Fixed Effect Model should be selected rather than the Random Effect Model. This is consistent with the theoretical expectation that Indonesian state-owned and regionally owned banks possess unique institutional characteristics that cannot be treated as random.

The Lagrange Multiplier Test indicates that both fixed and random effects outperform pooled ordinary least squares. Although random effects are statistically superior to pooled ordinary least squares, the significant Hausman Test result confirms that the Fixed Effect Model remains the most appropriate specification.

Based on all three diagnostic tests, the Fixed Effect Model is selected as the final estimation technique for both the baseline and moderated regression models.

The Modified Wald Test as displayed in Table 5 indicates significant heteroskedasticity in the residuals of the fixed effect model. This is common in banking panel data where bank size, lending structure, and risk profiles vary across institutions. The estimation therefore requires heteroskedasticity-consistent robust standard errors.

Table 5. Classical Assumption Tests

Assumption Test	Method Used	Test Statistic	Probability / Value
Heteroskedasticity Test	Modified Wald Test for FE model	Chi-square = 21.473	0.002
Autocorrelation Test	Wooldridge Test for serial correlation	F = 14.225	0.001
Multicollinearity Test	Variance Inflation Factor (VIF)	Mean VIF = 2.41	Maximum VIF = 4.76
Cross-sectional Dependence (CSD)	Pesaran CD Test	CD = 1.132	0.257
Normality of Residuals	Jarque–Bera Test	JB = 2.984	0.225

Source: Data Processed – 2025

The Wooldridge Test reveals a significant first order serial correlation. This typically arises because bank performance in one year is influenced by performance in previous years. To correct for this, cluster-robust or Driscoll–Kraay standard errors should be applied.

Variance inflation factor values remain well below the threshold of ten, indicating that the predictors do not exhibit problematic multicollinearity. This ensures that the regression coefficients are stable and interpretable.

The Pesaran CD statistic is not significant, suggesting no strong contemporaneous correlation across banks. This supports the assumption that shocks affecting one state bank do not immediately spill over into another within the same period.

The Jarque–Bera test shows that residuals are approximately normally distributed. Although normality is not strictly required for consistency, it enhances the reliability of inference in finite samples.

Baseline Model

The baseline panel regression (See Table 6) provides a detailed understanding of the determinants of bank profitability in Indonesian state-owned and regionally owned banks. The fixed effect model yields an adjusted R-squared of 0.598, indicating that approximately sixty percent of the variation in return on assets is explained by the included variables. Several predictors demonstrate statistically significant effects at the five percent level, illustrating the importance of both classical banking indicators and Indonesian-specific structural factors.

Based on Table 6, Loan to Deposit Ratio exhibits a positive and statistically significant coefficient of 0.02615 with a probability value of 0.012. This indicates that a one-point increase in the loan to deposit ratio leads to an estimated 0.02615-point increase in return on assets, holding other variables constant. The result reflects that more active intermediation enhances profitability through higher interest earning assets, consistent with the theoretical foundation of bank intermediation in developing financial systems.

Nonperforming Loans have a coefficient of negative 0.07321 with a probability value of 0.001, demonstrating the strongest negative effect among all predictors. This implies that a one-point rise in the nonperforming loan ratio reduces return on assets by approximately 0.07321 points. This substantial magnitude confirms that credit risk remains the dominant factor deteriorating earnings due to increased provisioning requirements and reduced effective interest income.

Net Interest Margin displays a coefficient of 0.12944 with a probability value of 0.001, indicating a strong and statistically significant positive effect. A one-point rise in the net interest margin increases return on assets by approximately 0.12944 points. This finding highlights the centrality of lending spreads as the primary earnings driver for Indonesian state banks, which operate in a financial environment characterised by relatively wide margins.

Operational Efficiency (BOPO) shows a negative and significant coefficient of negative 0.04112 with a probability value of 0.019. A one-point increase in the efficiency ratio decreases returns on assets by 0.04112 points, confirming that higher operating costs relative to income substantially weaken profitability. This aligns with the structural characteristics of BUMN and BUMD banks, which typically carry extensive branch networks and complex administrative responsibilities.

Table 6. Baseline Panel Regression Results (Main Effects Only)

Hypothesis	Variable	Coefficient	Std. Error	t-Statistic	Probability
	C (Constant)	0.004	0.002	2.095	0.046
H1	Capital Adequacy Ratio	0.018	0.011	1.574	0.127
H2	Loan to Deposit Ratio	0.026	0.009	2.658	0.012
H3	Nonperforming Loans	−0.073	0.018	−3.864	0.001
H4	Net Interest Margin	0.129	0.033	3.838	0.001
H5	Operational Efficiency	−0.041	0.016	−2.487	0.019
H6	Develop. Credit Orientation	0.022	0.010	2.234	0.034
H7	Coop. and Village Lending	0.014	0.006	2.312	0.029
H8	Green Lending Ratio	0.017	0.008	1.965	0.058
H9	ESG Performance Index	0.009	0.004	2.214	0.035
H10	Digital Capability Index	0.031	0.012	2.461	0.020
H11	Gov. Liquidity Support	0.012	0.005	2.219	0.034
	R-squared	0.673			
	Adjusted R-squared	0.598			
	F-Statistic	8.974			
	Probability (F-statistic)	0.000			
	Durbin–Watson Statistic	2.09			

Dependent Variable: Return on Assets (ROA)
Model: Fixed Effect (based on Chow, Hausman, LM tests)
Source: Data Processed – 2025

Developmental Credit Orientation has a positive coefficient of 0.02294 and a probability value of 0.034, indicating that banks with higher proportions of micro, small enterprise, and priority sector lending achieve stronger profitability. A one-point increase in developmental credit orientation raises returns on assets by 0.02294 points. This suggests that well targeted developmental lending supports both public policy goals and financial performance when supported by risk sharing mechanisms such as credit guarantees.

Cooperative and Village Lending (CVL) shows a positive and significant coefficient of 0.01482 with a probability value of 0.029. This implies that strengthening local economic development financing contributes directly to higher profitability, reflecting the productive nature of cooperative and village enterprise credit when managed effectively.

Green Lending Ratio has a coefficient of 0.01753 with a probability value of 0.058, indicating marginal significance at the ten percent level. A one-point increase in green lending is associated with a 0.01753-point increase in return on assets. This finding signals the emerging financial benefits of sustainable lending practices as mandated by Indonesia sustainable finance roadmap.

ESG Performance Index demonstrates a positive coefficient of 0.00925 with a probability value of 0.035. A one-point increase in the ESG index raises return on assets by 0.00925 points. This suggests that enhanced environmental and social disclosure is linked to improved financial outcomes, possibly through reputational advantages and improved stakeholder confidence.

The Digital Capability Index also reflects a significant positive coefficient of 0.03142 (p value = 0.020). This indicates that with each one-point increase in digital capability will increase profitability by 0.03142 points. More digitally mature and capable banks experience greater profitability by becoming more efficient, processing more transactions, and providing banks additional assurance in risk assessment.

With a p-value of 0.034, government liquidity support has a coefficient of 0.01294. A single point rise in government liquidity deployments increases the return on assets by 0.01294 points. This shows that the state's liquidity inflow strengthens the bank's capacity to advance developmental lending programmes and, therefore, increases profitability.

Overall, the baseline model illustrates that profitability in Indonesian state-owned, and regionally owned banks is shaped by a combination of traditional determinants such as credit risk and intermediation margins, together with structural factors such as developmental credit, sustainability commitments, digital transformation, and state liquidity support. These results provide a strong

foundation for the moderation model, which further examines whether digital capability and green lending condition the effects of risk, earnings, and developmental mandates on financial performance.

Moderation Model

The moderation model result in Table 7 provides deeper insight into how digital capability and sustainable finance commitments condition the relationships between classical banking determinants, developmental credit, and profitability. The inclusion of interaction terms increases the adjusted R squared to 0.688 compared with 0.598 in the baseline model, indicating that the moderated model offers stronger explanatory power for understanding return on assets in Indonesian state-owned and regionally owned banks.

Table 7. Moderation Regression Results (Full Interaction Model)

Hypothesis	Variable	Coeff.	Std. Error	t-Stat.	Prob.
	C (Constant)	0.003	0.002	1.782	0.087
	Capital Adequacy Ratio	0.016	0.011	1.463	0.157
	Loan to Deposit Ratio	0.024	0.009	2.615	0.013
	Nonperforming Loans	−0.056	0.017	−3.242	0.003
	Net Interest Margin	0.101	0.030	3.320	0.003
	Operational Efficiency	−0.037	0.015	−2.377	0.025
	Dev. Credit Orientation	0.018	0.009	1.921	0.065
	Coo. and Village Lending	0.013	0.005	2.212	0.036
	Green Lending Ratio	0.014	0.007	1.796	0.085
	ESG Performance Index	0.008	0.003	2.118	0.042
	Digital Capability Index	0.028	0.011	2.411	0.023
	Government Liquidity Support	0.011	0.005	2.127	0.041
H12	Interaction: NPL × DIG	0.031	0.010	3.067	0.005
H13	Interaction: NIM × DIG	0.044	0.018	2.444	0.021
H14	Interaction: DCO × GLR	0.027	0.011	2.392	0.024
	R-squared	0.752			
	Adjusted R-squared	0.688			
	F-Statistic	11.793			
	Probability (F-statistic)	0.000			
	Durbin–Watson Statistic	2.14			

Dependent Variable: Return on Assets (ROA)
Model: Fixed Effect with Robust Standard Errors

Source: Data Processed – 2025

Nonperforming Loans remain a significant negative predictor of profitability, with a coefficient of negative 0.05644 (p value = 0.003). This means that each one-point increase in the nonperforming loan ratio reduces return on assets by approximately 0.05644 points. However, the interaction term between Nonperforming Loans and Digital Capability is positive and significant, with a coefficient of 0.03192 (p value = 0.005). This indicates that digital capability mitigates the harmful effect of credit risk. For example, in banks with higher digital capability values, the negative slope of Nonperforming Loans on profitability becomes flatter. This suggests that digital infrastructure, automated credit scoring, real time monitoring, and predictive analytics reduce the degree to which deteriorating asset quality translates into earnings losses. The interaction therefore reflects the strategic value of digital transformation in strengthening risk management capacity.

Net Interest Margin remains a strong positive determinant of profitability with a coefficient of 0.10116 (p value = 0.003). Each one-point increase in the net interest margin raises return on assets by approximately 0.10116 points. Importantly, the interaction between Net Interest Margin and Digital Capability is also positive and significant, with a coefficient of 0.04457 (p value = 0.021). This shows that digital capability amplifies the beneficial effect of interest margins. Banks with stronger digital ecosystems appear able to translate higher lending spreads into greater profitability. This may be due to improved precision pricing, lower cost of service delivery, and enhanced customer retention in digital

channels. Thus, digital capability functions not only as a cost efficiency driver but also as a revenue enhancing strategic asset.

Developmental Credit Orientation continues to show a positive effect on profitability, although its significance becomes marginal at the ten percent level. The meaningful insight arises from its interaction with the Green Lending Ratio. The interaction term DCO multiplied by GLR carries a positive and significant coefficient of 0.02718 (p value = 0.024). This indicates that the profitability gains from developmental lending are strengthened when banks allocate a greater portion of their portfolio to environmentally aligned sectors. In other words, developmental credit yields higher returns in banks that also commit to sustainable finance practices. This pattern is consistent with Indonesia sustainable finance roadmap, which encourages banks to integrate environmental considerations into developmental and priority sector lending.

Digital Capability and Government Liquidity Support remain significant main effects in the moderated model. The coefficient for Digital Capability is 0.02851 (p value = 0.023), confirming that banks with stronger digital transformation obtain higher profitability. This result aligns with global evidence that digitalisation enhances operational efficiency, improves customer experience, and expands fee based and transaction-based income streams. Government Liquidity Support shows a coefficient of 0.01157 (p value = 0.041), indicating that state liquidity placements continue to improve profitability through expanded loanable funds and reduced funding constraints.

A comparison between the baseline and moderated models reveals several important insights. First, the magnitude of the Nonperforming Loans coefficient decreases in absolute terms in the moderated model, indicating that part of the negative effect is captured by the interaction term, which demonstrates the moderating role of digital capability. Second, the effect of Net Interest Margin also becomes partially conditional on digital capability, meaning that the profitability benefits of higher margins are greater in digitally advanced banks. Third, the developmental lending variable becomes more meaningful when examined in combination with green lending, suggesting that the financial benefits of state aligned lending are maximised in sustainable credit portfolios.

Overall, the moderation model demonstrates that profitability in Indonesian state banks is shaped not only by capital strength, liquidity, risk, and intermediation margins but also by the bank ability to harness digital technology and integrate sustainability practices. Digital capability emerges as a critical strategic factor that weakens the negative effects of risk exposures and strengthens the positive effects of earnings capacity. Sustainable finance promises to add developmental objectives to the environmental and climate change lending strategy and confirms that lending can accomplish financial and policy goals simultaneously. This confirms the importance of aligning technology and sustainability with development objectives to improve state and regionally owned banks.

Discussion

The findings of this study provide strong empirical support for the integrated theoretical framework developed in the literature review, which combines financial intermediation theory, risk management theory, development banking theory, sustainable finance theory, and the resource-based view of the firm. These perspectives jointly explain profitability in Indonesian state-owned and regionally owned banks, which operate under hybrid mandates that require the simultaneous pursuit of commercial viability, developmental objectives, and sustainability commitments. Structuring the discussion by hypothesis allows for a clearer articulation of how each empirical result contributes to theory and prior research.

Hypothesis 1: Capital Adequacy Ratio and Profitability

The results indicate that capital adequacy ratio does not exert a statistically significant direct effect on return on assets. From the standpoint of risk management theory, capital buffers are expected to enhance profitability by reducing insolvency risk, stabilising earnings, and strengthening market confidence (Nocco & Stulz, 2022). However, the absence of a significant direct effect suggests that for Indonesian - and regionally owned banks, capital adequacy primarily functions as a regulatory constraint rather than a performance enhancing mechanism.

This finding aligns with empirical studies showing that when banks maintain capital levels substantially above regulatory minima, additional capital yields diminishing marginal returns (Saleh &

Abu Afifa, 2020). In the Indonesian context, state banks are required to hold strong capital buffers to support developmental lending and absorb policy related risks. While this strengthens resilience, it may also limit asset expansion and compress returns if excess capital is not efficiently deployed. The result therefore supports the argument that capital adequacy is a necessary but not sufficient condition for profitability, reinforcing its prudential rather than earnings generating role.

Hypothesis 2: Loan to Deposit Ratio and Profitability

Loan to deposit ratio exhibits a positive and statistically significant relationship with profitability. This finding is strongly consistent with financial intermediation theory, which emphasises that banks generate value by transforming deposits into interest earning assets (Konstantakopoulou, 2023). In Indonesia's bank based financial system, lending activities remain the dominant source of income, making deposit utilisation a critical determinant of financial performance.

The positive effect suggests that state-owned and regionally owned banks are able to expand lending without triggering excessive liquidity risk, likely due to stable funding structures and government liquidity support mechanisms. Prior studies caution that excessively high loan to deposit ratios may undermine stability, yet the descriptive statistics indicate that Indonesian banks operate within prudent ranges. This implies that active intermediation, when supported by institutional safeguards, enhances profitability rather than exposing banks to liquidity stress (Bernard Azolibe, 2022; Wasiaturrahma, Sukmana, et al., 2020).

Hypothesis 3: Nonperforming Loans and Profitability

The strong negative impact of nonperforming loans confirms that credit risk remains the most dominant constraint on profitability. Risk management theory predicts that deteriorating asset quality directly erodes earnings through higher provisioning, reduced interest income, and increased recovery costs (Naili & Lahrichi, 2022). The magnitude of this effect in the Indonesian setting underscores the vulnerability of banks with extensive exposure to micro, small enterprise, and developmental lending.

This result reinforces Indonesian evidence showing that credit risk outweighs other prudential indicators in explaining profitability variation (Saleh & Abu Afifa, 2020). Although developmental lending supports policy objectives, it also exposes banks to borrower income volatility. The finding highlights that without effective screening and monitoring, policy-driven credit can quickly undermine earnings. This underscores the importance of complementary mechanisms such as digital capability and credit guarantees, which are examined through moderation effects in subsequent hypotheses.

Hypothesis 4: Net Interest Margin and Profitability

Net interest margin emerges as the strongest positive predictor of return on assets. This finding reaffirms financial intermediation theory by demonstrating that lending spreads remain the primary earnings engine for Indonesian state banks. In environments where fee-based income diversification is limited, interest margins play a central role in sustaining profitability (Bernard Azolibe, 2022).

The result also reflects the pricing power of Indonesian banks, which operate in markets characterised by informational asymmetry and limited competition in certain lending segments. For state-owned and regionally owned banks, interest income remains essential for financing operational costs and absorbing risks associated with developmental mandates. This finding therefore reinforces the structural dependence of state banking profitability on intermediation margins rather than alternative revenue sources.

Hypothesis 5: Operational Efficiency and Profitability

Operational inefficiency exhibits a significant negative effect on profitability, confirming efficiency theory predictions that higher operating costs weaken earnings capacity (Dinka & Asfaw, 2026). This effect is particularly salient for state-owned and regionally owned banks, which often face rigid organisational structures, extensive branch networks, and public service obligations.

The result indicates that revenue growth alone is insufficient to sustain profitability when cost structures remain inflexible. Even banks with strong intermediation margins and developmental lending portfolios experience profitability erosion if operational expenses rise disproportionately. This finding

highlights operational reform and digitalisation as critical levers for improving performance in state aligned financial institutions (Nurwulandari et al., 2022).

Hypothesis 6: Developmental Credit Orientation and Profitability

The positive effect of developmental credit orientation provides strong empirical support for contemporary development banking theory. Contrary to traditional concerns that policy driven lending undermines financial performance, the findings show that developmental credit can enhance profitability when supported by institutional arrangements such as credit guarantees and monitoring systems (Kanga et al., 2024; Loizos, 2023).

In Indonesia, developmental programmes such as microenterprise and priority sector lending are embedded within structured policy frameworks that reduce default risk and stabilise returns. This allows state banks to expand lending volume while maintaining manageable risk exposure. The result suggests that developmental credit should be viewed as a structural feature of state banking business models rather than a distortion, provided governance mechanisms are effective.

Hypothesis 7: Cooperative and Village Lending and Profitability

Cooperative and village lending shows a positive relationship with profitability, reflecting the benefits of relationship based and community embedded finance (Liu et al., 2024; Mtenga et al., 2024). Such lending reduces information asymmetry through social networks, repeated interactions, and collective accountability mechanisms. These features improve screening and monitoring outcomes, leading to more stable repayment performance. For Indonesian state and regional banks, cooperative and village lending also aligns closely with regional development mandates. The positive effect indicates that locally embedded credit can simultaneously generate financial returns and social impact, reinforcing the argument that inclusive finance need not compromise profitability when designed appropriately.

Hypothesis 8: Green Lending and Profitability

Green lending exhibits a positive association with profitability, supporting sustainable finance theory (Rahmania et al., 2024). Environmentally aligned projects often benefit from regulatory incentives, long term contracts, and lower transition risk, contributing to improved portfolio quality (Bouteska et al., 2023). In Indonesia, green lending is closely tied to infrastructure, energy, and environmental projects supported by government policy. These characteristics reduce uncertainty and enhance project viability. The finding indicates that sustainability commitments can strengthen rather than constrain financial performance, particularly in development-oriented banks.

Hypothesis 9: ESG Performance and Profitability

The positive effect of ESG performance reflects the signalling role of environmental, social, and governance practices. Strong ESG disclosure enhances stakeholder trust (Mohammad & Wasiuzzaman, 2021), regulatory credibility (Khamisu et al., 2024), and reputational capital (Handoyo, 2024), which translate into improved financial outcomes. For state-owned and regionally owned banks, ESG performance also reinforces institutional legitimacy in fulfilling public mandates. This legitimacy can improve access to funding, policy support, and customer confidence, thereby strengthening profitability. The result confirms ESG as a strategic asset rather than a compliance burden.

Hypothesis 10: Digital Capability and Profitability

Digital capability demonstrates a significant positive direct effect on profitability, consistent with the resource based view of the firm. Digital transformation enhances operational efficiency (Bui et al., 2020), expands transaction volume (Verhoef et al., 2021), and improves service delivery (Abu Al-Haija et al., 2025), allowing banks to convert intermediation activity into realised financial returns more effectively (Ferli et al., 2022). For state banks managing large and dispersed borrower bases, digital capability also reduces administrative burdens and supports scalable service provision. This finding confirms that digital transformation is not merely a technological upgrade but a strategic capability that strengthens performance.

Hypotheses 12 and 13: Digital Capability as a Moderator

The moderation results show that digital capability weakens the negative impact of nonperforming loans and strengthens the positive effect of net interest margin. These findings extend the resource based view by demonstrating that digital capability conditions how traditional banking determinants translate into profitability (Aqmala et al., 2025). Digitally advanced banks are better able to detect early warning signals, manage delinquency, and price risk accurately (Podder & Ghosh, 2025). As a result, credit risk exerts a smaller adverse effect on earnings, while intermediation margins generate higher realised returns. This highlights digital capability as a central strategic mechanism rather than a peripheral efficiency tool.

Hypothesis 14: Green Lending as a Moderator of Developmental Credit

The positive interaction between developmental credit orientation and green lending provides a key theoretical contribution by integrating development banking theory with sustainable finance theory. The finding indicates that developmental lending becomes more profitable when aligned with environmentally sustainable sectors.Green projects tend to exhibit stronger regulatory support, longer investment horizons, and lower long term risk exposure (Bui et al., 2020). When developmental credit is channelled toward such sectors, banks benefit from improved portfolio stability and reputational gains. This result confirms that sustainability alignment enhances the financial effectiveness of development oriented lending rather than constraining it (Handoyo & Anas, 2024).

Taken together, the findings demonstrate that profitability in Indonesian state-owned and regionally owned banks is shaped by a complex interaction between intermediation efficiency, risk containment, developmental orientation, sustainability alignment, and internal organisational capability. By deepening the discussion at the hypothesis level, this study advances theory and provides a nuanced explanation of contemporary state banking performance in development-oriented financial systems.

CONCLUSION

This study examined the determinants of financial performance in Indonesian state-owned and regionally owned banks by integrating traditional prudential indicators with developmental, sustainability, and digital transformation variables. Using panel data from 2019 to 2023, the analysis shows that profitability is shaped by an interplay of credit quality, intermediation margins, operational efficiency, developmental credit, sustainable finance practices, digital capability, and government liquidity placements. Nonperforming loans remain the strongest negative predictor of return on assets, while net interest margin continues to be a central driver of earnings. Developmental credit orientation and cooperative lending contribute positively to profitability, indicating that state mandated lending programmes can support financial performance when supported by appropriate institutional mechanisms.

Sustainable finance variables, particularly green lending and ESG performance, exhibit positive effects and enhance the financial benefits of developmental credit. Digital capability emerges as a critical moderating factor that mitigates the adverse impact of credit risk and strengthens the positive influence of intermediation margins. These findings underscore the strategic importance of digital transformation and sustainability integration within state aligned financial institutions. Overall, the study contributes to the literature by demonstrating that Indonesian state banks operate within a hybrid model where developmental mandates, technological capability, and sustainable finance jointly shape profitability.

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Authors' Contribution

JJ, DA, and MA contributed equally in the research process and writing the article.

Conflict of Interest

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All data of this study can be made available upon reasonable request.

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