Signifikan: Jurnal Ilmu Ekonomi
Volume 15(1), 2026: 283 - 296
P-ISSN: 2087-2046; E-ISSN: 2476-9223
https://doi.org/10.15408/sjie.v15i1.50225

Digital Financial Instruments, Financial Inclusion, and Regional Economic Performance in Indonesia

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JEL Classification:
O16
O33
R11
G21

Received: 19 January 2026

Revised: 26 February 2026

Accepted: 01 March 2026

Available online: April 2026

Published regularly: April 2026

ABSTRACT

Research Originality: This study examines the joint effects of digital financial instruments and financial inclusion indicators on regional economic performance during the post-pandemic period of accelerated digital transformation.

Research Objectives: The study aims to analyze the impact of electronic money transactions, third-party funds of Rural Banks (BPR), credit card transactions, and household internet access on Gross Regional Domestic Product (GRDP) per capita.

Research Methods: Using panel data from 38 provinces over the 2020–2024 period, this study employs panel regression analysis. Based on the Chow and Hausman tests, the Fixed Effects Model (FEM) is selected as the most appropriate estimator.

Empirical Results: The findings indicate that electronic money transactions, credit card transactions, and household internet access have a positive effect on GRDP per capita. In contrast, third-party funds of Rural Banks do not demonstrate a significant relationship with regional economic performance.

Implications: The results underscore the importance of strengthening digital financial ecosystems and expanding digital infrastructure to foster inclusive and sustainable regional economic growth in emerging economies.

Keywords:
digital finance; GRDP per capita; panel data; regional economy; financial inclusion; emerging economies

How to Cite:

Puspita, M. A., & Oktavilia, S. (2026). Digital Financial Instruments, Financial Inclusion, and Regional Economic Performance in Indonesia. *Signifikan: Jurnal Ilmu Ekonomi*, *15*(1), 283-296. https://doi.org/10.15408/sjie.v15i1.50225.

INTRODUCTION

Digital transformation in the financial sector has emerged as a major driver of structural change in modern economies, including those of developing countries (Barroso & Laborda, 2022; Dakwal et al., 2024). The rapid expansion of financial technology (fintech), electronic payment systems, and internet-based financial services has fundamentally reshaped patterns of access to and utilization of financial services by households and firms (Bollaert et al., 2021; Nugraha et al., 2022). From a development economics perspective, digital financial transformation not only reflects technological advancement but also functions as a structural mechanism that deepens financial intermediation, reduces transaction costs, and promotes more inclusive economic growth.

In Indonesia, the acceleration of digital payment systems has been actively promoted by both the monetary authority and the government. Bank Indonesia has designated electronic money, the Quick Response Code Indonesian Standard (QRIS), and various non-cash payment instruments as central pillars of the national digital economic architecture (Muchtar et al., 2024). The digitalization of payment systems aims to integrate formal and informal economic actors, expand financial inclusion, and reduce interregional disparities—particularly in provinces with limited access to conventional banking services (Widarwati et al., 2022). The post–COVID-19 pandemic period further accelerated this transformation, as mobility restrictions stimulated the widespread adoption of digital transactions across sectors.

The development economics literature consistently demonstrates that inclusive financial systems play a critical role in promoting economic growth and reducing inequality (Omar & Inaba, 2020; Menyelim et al., 2021). Access to financial services enables households and firms to manage risk, accumulate capital, and expand productive activities (Hasan et al., 2021). However, empirical evidence on the growth effects of financial inclusion remains inconclusive. Some studies report that fintech integration and enhanced financial inclusion positively contribute to economic growth and financial system stability (Rossi & Scalise, 2022; Azmeh & Al-Raeei, 2024; Sant'Anna & Figueiredo, 2024). Others argue that the magnitude and direction of these effects depend on institutional quality, financial system depth, and socio-economic readiness (Liu et al., 2021; Xi & Wang, 2023; Yakubi et al., 2022; Chinoda & Kapingura, 2024; Meniago, 2025). These divergent findings suggest that the economic impact of financial digitalization is neither automatic nor uniform across regions.

Alongside advances in digital technology, the determinants of financial inclusion are no longer confined to the presence of formal financial institutions; they also encompass digital infrastructure and digital financial literacy (Kass-Hanna et al., 2022; Choung et al., 2023). Indonesia exhibits substantial interprovincial heterogeneity in infrastructure quality, internet penetration, and financial intermediation capacity. This heterogeneity implies that the economic effects of digital transformation are likely to be asymmetric across provinces. Therefore, a macro-regional analytical framework is required to integrate multiple dimensions of the digital financial ecosystem within a unified empirical model.

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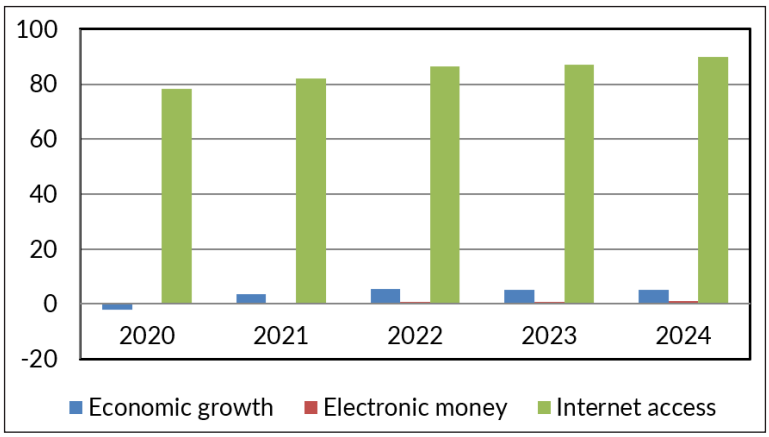
Figure 1 illustrates that economic growth moved in parallel with increases in electronic money transactions and household internet access during the post-pandemic period. The rising intensity of digital transactions coincided with economic recovery and improved performance across provinces. This co-movement suggests a potential structural linkage between digital economic development and regional economic performance. However, the observed relationship remains descriptive. The causal associations among electronic money transactions, financial intermediation indicators, digital access, and regional economic output have not yet been comprehensively examined within an interprovincial panel data framework in Indonesia.

Figure 1. Trends in Digital Economy Indicators and Indonesia's Economic Performance, 2020–2024



Source: Badan Pusat Statistik and Bank Indonesia; authors' calculations (2026).

Empirical studies in Indonesia generally conclude that fintech and digital payment systems enhance financial inclusion and transaction efficiency (Nugraha et al., 2022; Setiawan et al., 2021; Muchtar et al., 2024). However, most of these studies adopt micro-level or sectoral perspectives, focusing separately on household behavior, MSMEs, or financial institution performance. At the global level, Tay et al. (2022) observe that research on digital finance remains dominated by micro-level and cross-country analyses, with limited subnational investigation within a single developing country context.

Moreover, prior research tends to examine components of digital finance in isolation—such as financial literacy, fintech adoption, electronic money, or non-cash payments—without integrating these instruments into a unified empirical framework. In contrast, a combined analysis of digital payment intensity (electronic money and credit cards), financial intermediation depth (measured by third-party funds of regional financial institutions), and digital access (proxied by household internet access) more accurately reflects the structural complexity of the digital financial ecosystem. Such an integrated perspective is essential because multidimensional interactions among these components may generate heterogeneous economic effects across regions.

Rather than merely addressing the lack of regional-level evidence, this study departs conceptually from prior literature by positioning digital financial transformation as a

systemic regional growth driver, rather than solely as a financial inclusion instrument. By simultaneously modeling the digitalization of payments, banking intermediation capacity, and digital access within a unified provincial panel framework, this research captures the structural complementarity among digital infrastructure, financial depth, and transactional intensity. This specification enables an assessment of whether digital finance functions as an independent growth catalyst or as a reinforcing mechanism that amplifies existing regional economic capacity.

Based on this framework, the study analyzes the role of digital financial instruments and financial inclusion indicators in explaining regional economic performance across 38 provinces in Indonesia during the 2020–2024 period. Specifically, it examines the effects of electronic money transactions, third-party funds of regional financial institutions, credit card usage, and household internet access on Gross Regional Domestic Product (GRDP) per capita.

The novelty of this research lies not only in its empirical aspects but also in its structural and contextual dimensions. Structurally, it develops an integrated macro-regional model that treats digital payment systems, financial intermediation, and digital access as interrelated components of a unified digital financial ecosystem. Contextually, it exploits the 2020–2024 post-pandemic acceleration phase as a quasi-natural period of digital shock and structural adjustment, thereby capturing transformation dynamics rather than steady-state relationships. Methodologically, the use of a balanced interprovincial panel covering all 38 provinces allows for the identification of heterogeneous regional effects within a single national institutional setting. This design minimizes cross-country institutional bias while preserving meaningful regional variation.

Accordingly, this study advances the development economics literature by providing a meso-level empirical bridge between micro-level digital finance research and cross-country growth analyses. It offers evidence on how digital financial transformation reshapes regional growth structures within a large developing economy and generates policy-relevant insights for designing territorially differentiated digital financial strategies that support inclusive and sustainable economic development in Indonesia.

METHODS

This study employs an explanatory quantitative design to examine the causal relationships among digital financial instruments, financial inclusion indicators, and regional economic performance in Indonesia. This approach is appropriate because it aims to test theoretically grounded hypotheses and explain causal linkages among variables based on established theoretical frameworks and prior empirical evidence (Taherdoost, 2022). Through this design, the study not only describes observable phenomena but also statistically evaluates the influence of independent variables on the dependent variable.

The study utilizes secondary panel data that combine cross-sectional and time-series dimensions. The unit of analysis consists of 38 provinces in Indonesia, observed over the period 2020–2024, yielding a balanced panel of 190 observations (38 provinces over

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five years). Panel data are employed because they increase the number of observations and degrees of freedom, mitigate potential multicollinearity, and control for unobserved heterogeneity across provinces (Ocharive & Iworiso, 2024) The selected time frame captures the phase of accelerated digital financial transformation following the COVID-19 pandemic.

The data were obtained from official publications of the Central Statistics Agency (Badan Pusat Statistik), Bank Indonesia, and the Financial Services Authority (Otoritas Jasa Keuangan). Data collection was conducted through documentary analysis by compiling consistently and systematically published annual provincial-level statistics (Sardana et al., 2023). The use of official institutional sources enhances data validity, reliability, and cross-regional comparability.

The dependent variable is Gross Regional Domestic Product (GRDP) per capita at current prices, which serves as a proxy for regional economic performance. GRDP per capita reflects the average income level of a region's population and its productive capacity. The independent variables include: (1) the value of electronic money transactions as an indicator of digital payment intensity; (2) third-party funds of conventional Rural Banks (BPR) as a measure of local financial intermediation; (3) the value of credit card transactions as a proxy for formal consumer credit activity; and (4) the percentage of households with internet access as an indicator of digital infrastructure readiness.

Table 1. Operational Definitions and Measurement of Research Variables

Variable	Operational Definition	Unit	Data Source
GRDP per Capita	The total value of final goods and services produced in a province in one year, divided by the total population at current prices	Million rupiah per capita	BPS
Electronic Money Transactions	Total annual value of electronic money transactions at the provincial level	Billion rupiah	Bank Indonesia
Third-Party Funds of Rural Banks (BPR)	Total public funds collected by conventional Rural Banks in a province	Billion rupiah	OJK
Credit Card Transactions	Total annual value of credit card transactions at the provincial level	Million rupiah	Bank Indonesia
Households with Internet Access	Percentage of households that accessed the internet within the last three months	Percent	BPS

The econometric specification is formulated as follows:

$$GRDP_{it} = \alpha + \beta_1 EM_{it} + \beta_2 BPR_{it} + \beta_3 CC_{it} + \beta_4 INT_{it} + \varepsilon_{it} \quad (1)$$

Where $GRDP_{it}$ denotes GRDP per capita of province i in year t; EM_{it} represents the value of electronic money transactions; BPR_{it} denotes third-party funds of conventional Rural Banks; CC_{it} represents the value of credit card transactions; INT_{it} denotes the percentage of households with internet access; α is the intercept term; β_1–β_4 are the regression coefficients; and ε_{it} is the error term.

Panel data regression is estimated using three alternative specifications: the Common Effects Model (CEM), the Fixed Effects Model (FEM), and the Random Effects Model

(REM) (Baltagi, 2021). Model selection is conducted sequentially. The Chow test is used to compare the CEM and FEM, while the Hausman test is used to determine which model is most appropriate between the FEM and REM. The selected specification forms the basis for subsequent inferential analysis. Hypothesis testing is conducted using the F-test to assess the joint significance of all independent variables on GRDP per capita and the t-test to evaluate the partial effect of each independent variable. Statistical significance is assessed at the 1%, 5%, and 10% levels. The coefficient of determination (R^2) is used to evaluate the model's explanatory power in accounting for variations in regional economic performance.

Table 2. Multicollinearity Test Results

Variance Inflation Factor (VIF) Analysis	
Variable	**VIF**
Electronic Money (EM)	3.59
Rural Bank Third-Party Funds (TPF)	3.50
Credit Cards (CC)	1.22
Internet Access (INT)	1.17
Mean VIF	2.37

Note: The VIF values for all explanatory variables are below the conventional threshold of 10, indicating that multicollinearity does not pose a serious concern in the estimated model.

Source: Authors' calculations based on data from Statistics Indonesia (Badan Pusat Statistik), Otoritas Jasa Keuangan, and Bank Indonesia, processed using Stata 17 (2026).

To ensure the validity of the estimators, classical diagnostic tests are performed, including a multicollinearity test using the Variance Inflation Factor (VIF) and a heteroskedasticity test using the Glejser procedure. If heteroskedasticity is detected, the model is re-estimated using robust standard errors to obtain consistent and efficient parameter estimates. All statistical analyses are conducted using Stata version 17.

Table 3. Heteroskedasticity Test Results

Heteroskedasticity Test			
Test	**Statistic**	**p-Value**	**Conclusion**
Glejser Test	2.54	0.111	No heteroskedasticity detected

Note: The Glejser test produces a p-value of 0.111, which exceeds the 5% significance level. Accordingly, the null hypothesis of homoskedasticity cannot be rejected, indicating that the regression model is not heteroskedastic.

Source: Authors' calculations based on data obtained from Statistics Indonesia (Badan Pusat Statistik), Otoritas Jasa Keuangan, and Bank Indonesia, processed using Stata 17 (2026).

RESULTS AND DISCUSSION

The estimation results indicate that digital finance–related variables—namely, electronic money transactions, credit card usage, and the percentage of households with internet access—positively affect GDP per capita in Indonesia. In contrast, third-party funds of conventional Rural Banks (BPR) do not exhibit a statistically significant impact. Based on the Chow test (p-value = 0.000) and the Hausman test (p-value = 0.000),

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the Fixed Effects Model (FEM) was selected as the most appropriate specification (see Table 4). These results confirm the presence of time-invariant unobserved provincial heterogeneity that is correlated with the explanatory variables. Accordingly, structural characteristics, institutional capacity, and socio-economic conditions across provinces contribute systematically to variations in regional economic performance. The classical assumption tests presented in Tables 2 and 3 indicate that the model satisfies the standard econometric adequacy criteria. No serious multicollinearity is detected, as reflected by an average VIF of 2.37, and there is no evidence of heteroskedasticity (p-value = 0.111).

Individually, electronic money transactions have a positive effect on GDP per capita. An increase in digital payment intensity is associated with higher regional income levels. This finding suggests that digital payment systems enhance transaction efficiency, reduce transaction costs, and accelerate the velocity of money, thereby stimulating aggregate economic activity. Beyond efficiency gains, digital payments reduce information asymmetries and expand financial inclusion—particularly among previously unbanked populations—thereby enlarging the effective market size and stimulating productivity-enhancing investments. From an endogenous growth perspective, improvements in payment technology generate spillover effects by facilitating the diffusion of innovation and strengthening market integration across regions.

Table 4. Fixed Effects Model Estimation Results

Dependent Variable: Gross Regional Domestic Product (GRDP) per Capita			
Variable	**Coefficient**	**t-Statistic**	**p-Value**
Electronic Money (EM)	2,852.449	6.44	0.000***
Rural Bank Third-Party Funds (BPR)	228.040	0.93	0.353
Credit Cards (CC)	337,688.100	3.95	0.000***
Internet Access (INT)	2,320.131	3.37	0.001***
Constant	111,906.400	1.73	0.085
Model Diagnostics			
Statistic	**Value**		
Adjusted R-squared	0.867		
F-statistic	42.79		
Prob > F	0.000		
Number of Observations	190		
Model Selection Tests			
Test	**Probability**	**Decision**	
Chow Test	0.000***	FEM	
Hausman Test	0.000***	FEM	

Notes: *** p < 0.01; ** p < 0.05; * p < 0.10.

Source: Authors' calculations based on data obtained from Statistics Indonesia (Badan Pusat Statistik), the Financial Services Authority (Otoritas Jasa Keuangan), and Bank Indonesia, processed using Stata 17 (2026).

This result is consistent with Wasiaturrahma and Kurniasari (2021), who argue that the development of digital finance strengthens regional economic growth through

improved financial access and transaction efficiency. Chen and Xiao (2025) further demonstrate that digital payment ecosystems integrate formal and informal sectors, thereby expanding the production base and income-generating capacity. Additional evidence from Koomson et al. (2020) and Djahini-Afawoubo et al. (2023) indicates that mobile money adoption significantly increases household income and facilitates poverty reduction through enhanced risk-sharing mechanisms. Oanh and Dinh (2024) also find that digital finance deepens financial systems and enhances economic stability in emerging economies, while Verma et al. (2023) document that ICT-driven financial development stimulates long-term economic growth in developing countries. In light of these studies, the present study provides further empirical evidence that digital transaction instruments function not merely as substitutes for conventional payment methods but also as catalysts of regional structural transformation, particularly in provinces with expanding digital ecosystems.

Credit card use likewise exhibits a positive effect on GDP per capita. Credit-based non-cash instruments help sustain aggregate demand and support economic circulation, particularly in more urbanized provinces. From a development economics perspective, credit cards facilitate consumption smoothing and short-term liquidity management, thereby enhancing regional demand stability. In Keynesian terms, expanded access to consumer credit increases the marginal propensity to consume, amplifying the short-run multiplier effect on output. Moreover, higher credit card penetration may signal greater financial sophistication and institutional maturity, thereby indirectly supporting private-sector expansion.

These findings are consistent with Kredina et al. (2022), who report a positive relationship between non-cash transactions and regional economic growth through the consumption channel. Luo and Zhu (2025) similarly find that credit card expansion increases economic output, particularly in regions with higher levels of financial literacy. Eichengreen et al. (2024) further argue that deeper consumer credit markets support aggregate demand and accelerate economic recovery in emerging markets. Meanwhile, Yang and Zhang (2020) demonstrate that broader financial access enhances economic growth by relaxing liquidity constraints faced by households and firms. However, in contrast to digital payment instruments—which promote long-term structural efficiency—credit cards appear to function primarily as demand stabilizers rather than as agents of production-structure transformation. This distinction reinforces the argument that not all forms of financial deepening exert identical growth effects; their developmental impact depends on whether they expand productive capacity or predominantly stimulate short-term consumption.

Household internet access positively affects GDP per capita, underscoring the critical role of digital infrastructure in boosting regional economic performance. Internet penetration strengthens connectivity, broadens access to digital financial services, and encourages participation in e-commerce and platform-based economic activities (De Clercq et al., 2023; Okolo et al., 2025). More importantly, digital infrastructure reduces geographic barriers, facilitates knowledge diffusion, and improves labor market matching efficiency, thereby increasing total factor productivity at the regional level. From the perspective of new economic geography, enhanced digital connectivity mitigates spatial inequality by integrating peripheral regions into broader economic networks.

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Zhang et al. (2021) show that digital infrastructure significantly improves regional economic performance. Further Trinugroho et al. (2022) document that internet penetration in Indonesia accelerates digital financial adoption and promotes economic growth, particularly in more urbanized provinces. Supporting this view, Briglauer et al. (2025) find that broadband infrastructure significantly increases GDP growth across OECD countries, while Verma et al. (2023) demonstrate that ICT expansion exerts a measurable positive impact on economic growth in developing economies. Compared with these studies, the present study strengthens the argument by empirically integrating digital finance and digital infrastructure variables within a unified panel data framework, thereby highlighting their complementary and mutually reinforcing roles in explaining regional income disparities.

Conversely, third-party funds of conventional Rural Banks (BPR) do not exert a statistically significant effect on GDP per capita. Although the estimated coefficient is positive, it lacks sufficient explanatory power at the macro-regional level. This finding suggests that increased fund mobilization by local microfinance institutions has not been fully translated into higher aggregate output. A deeper interpretation suggests that financial intermediation at the micro level may remain concentrated in low-productivity sectors, with limited spillover effects on industrial upgrading or technological innovation. In addition, the relatively small asset base of BPRs may constrain their capacity to finance scalable, productivity-enhancing investments.

This result aligns with Konstantakopoulou (2023), who argues that the growth impact of local financial intermediation depends critically on the quality of credit allocation and its linkages to productive sectors. Sirag et al. (2025) similarly contend that finance–growth relationships are nonlinear and conditional on the stage of financial development. However, this finding contrasts with Putra et al. (2026), who identify a positive contribution of BPR funds to regional growth in areas characterized by strong MSME ecosystems and supportive local policies. Asante et al. (2023) further emphasize that small financial institutions can stimulate growth when institutional quality and regulatory frameworks are robust. These differences suggest that the effectiveness of microfinance institutions depends on regional structural conditions, institutional capacity, and the degree of integration with digital financial systems.

Overall, the empirical evidence indicates that digital financial instruments and digital infrastructure exert a more consistent and robust influence on regional economic performance than conventional financial intermediation. The strengthened analysis demonstrates that technology-based financial deepening contributes not only through demand stimulation but also through structural efficiency gains, productivity enhancement, and market integration. Digitalization, therefore, emerges as a central driver of regional economic transformation in Indonesia during the period under study. These findings reinforce and extend the growing empirical consensus that digital finance and digital connectivity constitute key determinants of regional growth dynamics. Accordingly, regional development strategies should prioritize strengthening the digital ecosystem, enhancing digital financial literacy, improving institutional quality, and

integrating conventional financial institutions into technology-based economic networks to foster inclusive and sustainable regional growth.

CONCLUSION

This study examines the contribution of digital financial instruments and financial inclusion to regional economic performance in Indonesia at the provincial level during the post-pandemic phase of digital acceleration. Using panel data estimated through a Fixed Effects Model (FEM), the research objectives have been systematically addressed. The results indicate that digital financial variables—namely, electronic money transactions, credit card usage, and the proportion of households with internet access—positively affect Gross Regional Domestic Product (GRDP) per capita. These findings confirm that the deepening of digital finance and the expansion of digital infrastructure make a substantive contribution to strengthening regional economic performance. In contrast, third-party funds mobilized by Rural Banks (BPR) do not exhibit a significant effect on GRDP per capita. This finding suggests that conventional financial intermediation at the regional level has not yet translated into broader productivity gains, particularly in an increasingly digitalized economy. Accordingly, the effectiveness of financial inclusion appears to be enhanced when embedded within a robust digital financial ecosystem rather than when reliant solely on traditional banking mechanisms.

From a policy perspective, these findings underscore the importance of prioritizing the development of a comprehensive digital financial ecosystem within regional development strategies. The government should accelerate the equitable expansion of digital infrastructure, particularly in provinces with low internet penetration, to mitigate interregional digital disparities. The regulatory framework should also promote the integration of local financial institutions, including Rural Banks, into digital platforms in order to enhance efficiency, expand service outreach, and strengthen competitiveness. In addition, digital financial literacy programs should be scaled up to ensure that increased access to digital financial services translates into productive economic activity rather than remaining confined to transactional use. Effective coordination among monetary authorities, financial regulators, and regional governments is essential to foster innovation while safeguarding financial system stability. Providing targeted incentives for the adoption of digital payment systems among micro, small, and medium enterprises (MSMEs), alongside integrating digital finance into local value chains, may further amplify the growth effects identified in this study.

This study has several limitations. The analysis relies primarily on macro-level quantitative indicators and therefore does not fully capture qualitative dimensions of digital finance usage, such as service efficiency, depth of utilization, and user capability. Moreover, institutional quality and financial literacy were not explicitly incorporated as moderating variables, although both may influence the magnitude and transmission of the relationship between digital finance and economic performance. Future research should incorporate institutional indicators, measures of digital financial literacy, nonlinear modeling frameworks, and spatial econometric approaches to more comprehensively

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capture interregional spillover effects and structural heterogeneity. Overall, this study provides empirical evidence that digital financial transformation constitutes a strategic driver of regional economic growth in Indonesia. Strengthening digital financial inclusion—supported by adequate infrastructure, institutional integration, and enhanced literacy—represents a critical prerequisite for fostering inclusive, resilient, and sustainable regional development.

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