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The Influence of Digital Financial Inclusion Strategy on Digital Economic Transformation of MSMEs in Indonesia

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ABSTRACT

The transformation of the digital economy has become one of the main drivers of economic growth in various developing countries, including Indonesia, where Micro, Small, and Medium Enterprises (MSMEs) play an important role in the national economic structure. However, many MSMEs still face limited access to formal financial services and digital technology that can support the business transformation process. This study aims to analyze the influence of digital financial inclusion strategies on the transformation of the MSME digital economy in Indonesia and identify the role of digital financial literacy, regulatory quality, and digital infrastructure in strengthening these relationships. This study uses a mixed-method approach by combining quantitative and qualitative methods. Quantitative data was obtained through a survey of 398 MSMEs in five provinces in Indonesia, while qualitative data was obtained through in-depth interviews and focus group discussions (FGD) with MSME actors and fintech stakeholders. Data analysis was carried out using Structural Equation Modeling (SEM) and thematic analysis to strengthen the interpretation of the research results. The results of the study show that the digital financial inclusion strategy has a positive and significant influence on the transformation of the digital economy of MSMEs, especially through the adoption of digital payments and fintech-based credit access. In addition, digital financial literacy has been proven to play a role as a mediating variable that strengthens the relationship, while the quality of regulation and digital infrastructure serves as a moderation factor that magnifies the impact of digital financial inclusion on the transformation of MSMEs. The implications of this study show that integrated policies between increasing access to digital financial services, strengthening digital financial literacy, and developing supporting infrastructure and regulations are essential to accelerate the digital transformation of MSMEs. This research makes an original contribution by offering an integrated analytical framework that connects digital financial inclusion, digital financial literacy, and institutional factors as the main drivers of the transformation of the MSME digital economy in developing countries.

INTRODUCTION

The rapid advancement of digital technology has fundamentally reshaped the global economic landscape, with Micro, Small, and Medium Enterprises (MSMEs) standing at a critical crossroads of transformation (Chusnul Jurnalita, 2024; Jurnalita, 2024; Neelam Kumari, 2025). In Indonesia, MSMEs constitute the backbone of the national economy, contributing approximately 61.07% of Gross Domestic Product (GDP) and absorbing more than 97% of the total domestic workforce (Ministry of Cooperatives and SMEs, 2023). Despite their pivotal economic role, a significant proportion of these enterprises remain excluded from formal financial systems, limiting their capacity to access capital, expand operations, and integrate into digital value chains. According to the World Bank (2022), approximately 51% of Indonesian adults were still unbanked, while a considerable share of MSMEs relied on informal lending mechanisms that carry high interest burdens and lack transparency. The emergence of digital financial inclusion, encompassing mobile

banking, digital payments, peer-to-peer (P2P) lending, and financial technology (fintech) ecosystems, presents an unprecedented opportunity to bridge this structural gap. The Indonesian government, through the National Strategy for Financial Inclusion (SNKI) and the Financial Services Authority (OJK), has progressively implemented digital financial inclusion initiatives targeting MSMEs in both urban and rural areas. However, despite these policy efforts, the extent to which digital financial inclusion strategies effectively catalyze the broader digital economic transformation of MSMEs remains an empirically underexplored question. With approximately 64.2 million MSME units operating across various sectors and regions (BPS, 2022), understanding the mechanisms through which digital financial access translates into digital transformation outcomes is not only academically significant but also critical for evidence-based policymaking in Indonesia's pursuit of an inclusive digital economy.

Scholarly discourse on this subject has evolved across several interconnected streams of research, yet critical gaps remain unaddressed. The first category of literature focuses on digital financial inclusion as a standalone construct, examining its determinants, barriers, and outcomes. Studies by Demirguc-Kunt et al. (2018), Ozili (2018) Mushtaq & Bruneau (2019), and Asongu & Nwachukwu (2018) consistently demonstrate that access to digital financial services improves household welfare, reduces income inequality, and enhances savings behavior, particularly among underserved populations. Grzegorczyk (2018) further argue that the quality of digital financial ecosystems, including regulatory frameworks and digital infrastructure, plays a decisive role in shaping inclusion outcomes. However, these studies predominantly focus on individual consumers rather than enterprise-level impacts, leaving a gap in understanding how MSME-targeted digital financial inclusion strategies operate differently from general financial inclusion programs. The second category of research examines the digital transformation of MSMEs, exploring how technology adoption affects business performance, competitiveness, and market integration. Bharadwaj et al. (2013) Fitzgerald et al. (2014), and Warner and Wager (2019) conceptualize digital transformation as a multidimensional process involving the integration of digital technologies into business models, operations, and customer engagement. More specifically for MSMEs, studies by Nambisan et al. (2017), Moeuf et al. (2018), and Kraus et al. (2021) highlight the importance of digital readiness, managerial capabilities, and ecosystem support in enabling successful digital transitions. Yet, these studies tend to treat financial access as a peripheral condition rather than a central driver of digital transformation, underestimating the strategic role that financial inclusion plays in enabling technology investment. A third category of literature investigates the relationship between fintech, financial inclusion, and economic outcomes in emerging economies. Research by Gomber et al. (2017), Gabor & Brooks (2017), Lagna & Ravishankar (2022) and Shen et al. (2020) suggests that fintech-enabled financial services can accelerate economic formalization, increase transaction efficiency, and reduce information asymmetries for small businesses. In the Indonesian context, studies by Abramova and Bohme (2016) and Bahri (2019) acknowledge the role of OJK's regulatory sandbox and fintech ecosystem in expanding financial access for MSMEs, but these works remain largely descriptive and fail to empirically test the causal pathways through which specific digital financial inclusion strategies influence the stages of digital economic transformation. Collectively, these three streams of literature reveal a persistent gap: the absence of an integrated analytical framework that connects digital financial inclusion strategies as independent variables with the

multidimensional digital economic transformation of MSMEs as dependent outcomes, particularly within the socioeconomic and regulatory context of Indonesia.

This study aims to address the identified gaps by constructing and empirically testing a comprehensive framework that examines the influence of digital financial inclusion strategies on the digital economic transformation of MSMEs in Indonesia. Specifically, the research seeks to achieve three interrelated objectives. First, it aims to identify and operationalize the key dimensions of digital financial inclusion strategies applicable to Indonesian MSMEs, including digital payment adoption, access to fintech-based credit, digital financial literacy, and the role of regulatory enablement. Second, the study seeks to measure the degree of digital economic transformation across MSME sectors by analyzing indicators such as e-commerce integration, digital marketing utilization, cloud-based operational tools, and data-driven decision-making capabilities. Third, and most crucially, the research endeavors to establish the directional and magnitude-based relationships between these two constructs, controlling for contextual moderating variables such as firm size, sector, geographic location, and digital infrastructure availability. By bridging the conceptual divide between financial inclusion literature and digital transformation scholarship, this study contributes an empirically grounded model that can inform both academic theory-building and practical policy design for Indonesia's MSME digital economy agenda.

Drawing from the resource-based view (RBV) of the firm, the Technology Acceptance Model (TAM) (Fred, 2017; Mensah, 2021), and the financial intermediation theory, this study advances several core arguments and hypotheses. It is argued that digital financial inclusion strategies function as strategic resource enablers that lower the barriers to digital investment, thereby accelerating the pace and depth of MSME digital transformation. Based on this theoretical grounding, the first hypothesis posits that access to digital financial services, including mobile payments, digital banking, and fintech-based lending, has a significant and positive influence on the digital economic transformation of MSMEs in Indonesia (H1). Furthermore, it is hypothesized that digital financial literacy, as a mediating variable, amplifies the positive relationship between digital financial inclusion and digital transformation outcomes, as MSMEs with higher digital financial competence are better positioned to leverage available financial tools for operational digitization (H2). A third hypothesis suggests that regulatory quality and institutional support from bodies such as OJK and Bank Indonesia moderate the relationship between digital financial inclusion and digital transformation, with stronger regulatory frameworks positively strengthening the inclusion-transformation nexus (H3). Finally, the study hypothesizes that the influence of digital financial inclusion on digital transformation varies significantly across MSME sectors and geographic regions, with technology-intensive sectors and urban enterprises demonstrating stronger transformation responses (H4). These hypotheses, grounded in established theory and supported by the empirical literature, form the analytical backbone of this research and are tested through a mixed-methods approach combining structural equation modeling (SEM) with qualitative case analysis.

RESEARCH METHOD

The unit of analysis in this study is Micro, Small, and Medium Enterprises (MSMEs) operating in Indonesia that have been exposed to, or are actively utilizing, at least one form of digital financial inclusion service, including mobile banking, digital payment platforms, fintech-based lending, or digital insurance products. The study focuses on MSMEs as organizational entities rather than

individual entrepreneurs, treating each enterprise as a single unit whose characteristics, digital financial access patterns, and transformation outcomes are measured collectively. The selection of MSMEs as the primary unit of analysis is grounded in their macroeconomic significance and the structural vulnerabilities they face in transitioning toward digital economic models. More specifically, the study targets MSMEs from five strategic sectors identified by the Indonesian Ministry of Trade as high-potential for digital transformation: food and beverage, fashion and crafts, agriculture and agribusiness, trade and retail, and digital creative industries. These sectors collectively represent a diverse cross-section of the MSME landscape in terms of technology readiness, market orientation, and financial inclusion needs. The geographical scope of the study covers five provinces representing different levels of digital economic development and financial infrastructure: DKI Jakarta, West Java, East Java, North Sumatra, and East Nusa Tenggara. This geographic diversification ensures that the findings reflect not only the advanced digital economy contexts of major urban centers but also the distinct challenges and opportunities present in semi-urban and rural MSME clusters.

This study employs a mixed-methods research design, integrating quantitative survey-based analysis with qualitative case study inquiry. The rationale for adopting a mixed-methods approach is rooted in the epistemological complexity of the research problem: while the quantitative strand allows for the systematic measurement of relationships between digital financial inclusion strategies and digital economic transformation outcomes across a large and representative sample, the qualitative strand provides depth of understanding regarding the mechanisms, contextual conditions, and experiential dimensions that statistical models cannot adequately capture. The quantitative component is designed within a positivist-explanatory framework and employs a cross-sectional survey design, which is appropriate for testing causal hypotheses and estimating the strength and direction of relationships between the study's key constructs at a specific point in time. The qualitative component follows an interpretivist tradition and utilizes an embedded multiple-case study design (Yin, 2018), which is particularly suited for exploring how and why digital financial inclusion strategies produce transformation effects within specific MSME contexts. The integration of both methods follows a sequential explanatory strategy (Johhn w. Creswell; Vicki L. Plano Clark, 2018), wherein the quantitative findings are first generated and analyzed, and the qualitative data is subsequently collected to explain, elaborate, or contextualize the statistical results. This sequencing ensures methodological coherence while maximizing the complementarity of both approaches in generating a comprehensive understanding of the phenomenon under investigation.

The data for this study are drawn from both primary and secondary sources. The primary quantitative data are obtained from MSME respondents through a structured survey instrument, while the primary qualitative data are collected from purposively selected MSME owners, managers, fintech platform representatives, and OJK regional officers who serve as key informants. Secondary data are sourced from official statistical databases and institutional reports, including the BPS National Economic Census (2022), OJK Financial Inclusion Survey (2022), Bank Indonesia Digital Economy and Finance Reports (2021–2023), World Bank Enterprise Surveys for Indonesia, and the Ministry of Cooperatives and SMEs' MSME Development Reports. Additionally, secondary qualitative data are drawn from regulatory policy documents, fintech industry white papers, and OJK circular letters pertaining to digital financial inclusion. The integration of primary and secondary data sources serves two purposes: first, it provides triangulation that strengthens the validity and

reliability of the empirical findings; second, it situates the primary survey data within a broader structural and institutional context, enabling more nuanced interpretations of the relationship between digital financial inclusion and MSME transformation. All secondary data sources are critically evaluated for recency, institutional credibility, and methodological transparency prior to their inclusion in the analysis.

Data collection proceeds through two coordinated phases. In the quantitative phase, a structured questionnaire is administered to a target sample of 420 MSME respondents, determined using Krejcie and Morgan's (1970) sampling formula applied to the estimated MSME population across five provinces, with a proportional stratified random sampling technique applied to ensure representativeness across sectors, geographic locations, and enterprise size categories. The questionnaire is developed based on validated scales from prior studies, adapted to the Indonesian MSME context. It consists of four main measurement sections: (1) digital financial inclusion strategy, operationalized through 18 items measuring digital payment adoption, fintech credit access, digital financial literacy, and regulatory perception; (2) digital economic transformation, measured through 22 items across e-commerce integration, digital marketing, cloud operations, and data-driven management; (3) moderating variables including regulatory quality and digital infrastructure (8 items); and (4) control variables including firm age, size, sector, and owner education level. The instrument uses a five-point Likert scale and is pilot-tested with 40 respondents to assess internal consistency and construct validity prior to full deployment. Questionnaires are distributed through a combination of online (Google Forms via WhatsApp groups and MSME community platforms) and offline (field enumerator-assisted) methods to maximize response rates, particularly in rural and semi-urban areas. In the qualitative phase, semi-structured in-depth interviews are conducted with 24 key informants across six cases (two per province from high and low digital transformation performance groups), using an interview guide developed from the quantitative findings. Each interview lasts between 60 and 90 minutes and is recorded with the informant's consent. Additionally, a Focus Group Discussion (FGD) is conducted in each province with 6–8 MSME practitioners and fintech stakeholders to validate and enrich the emerging qualitative insights.

Data analysis follows a sequential and iterative process aligned with the mixed-methods design. For the quantitative strand, analysis proceeds in three stages. First, descriptive statistical analysis is conducted to examine the distribution, central tendency, and variability of all study variables. Second, confirmatory factor analysis (CFA) using AMOS 26.0 is performed to assess the measurement model, evaluating convergent validity, discriminant validity, and composite reliability of all constructs. Third, structural equation modeling (SEM) with maximum likelihood estimation is applied to test the proposed hypotheses regarding the direct effects of digital financial inclusion strategies on digital economic transformation, as well as the mediating role of digital financial literacy and the moderating effects of regulatory quality and digital infrastructure. Model fit is assessed using standard indices including CFI, TLI, RMSEA, and SRMR. For the qualitative strand, interview and FGD data are transcribed verbatim in Bahasa Indonesia, then translated and analyzed through a three-stage thematic analysis process following Braun & Clarke (2006) framework: initial coding, theme development, and thematic mapping. NVivo 14 is used to manage and systematize the qualitative coding process. The qualitative themes are subsequently integrated with the quantitative SEM results in a joint display matrix (Guetterman et al., 2015), which enables systematic comparison and synthesis of findings from both strands to produce a unified, theoretically

rich interpretation of how digital financial inclusion strategies drive digital economic transformation in Indonesian MSMEs.

RESULT AND DISCUSSION

Respondent Profile and Descriptive Statistics

A total of 420 structured questionnaires were distributed to MSME respondents across five provinces in Indonesia, of which 398 were returned and deemed valid for analysis, yielding a response rate of 94.8%. The sample distribution reflects the proportional stratified random sampling design: DKI Jakarta contributed 92 respondents (23.1%), West Java 88 (22.1%), East Java 84 (21.1%), North Sumatra 76 (19.1%), and East Nusa Tenggara 58 (14.6%). The relatively lower representation from East Nusa Tenggara is consistent with the regional MSME population density and aligns with the sampling frame derived from the BPS National Economic Census (2022). In terms of enterprise size, 61.3% of respondents were classified as micro enterprises, 28.4% as small enterprises, and 10.3% as medium enterprises, reflecting the actual distribution of MSME categories in Indonesia as reported by the Ministry of Cooperatives and SMEs (2023). Sector-wise, food and beverage MSMEs constituted the largest group (27.9%), followed by trade and retail (24.4%), fashion and crafts (18.8%), agriculture and agribusiness (16.6%), and digital creative industries (12.3%). This distribution enables cross-sector comparative analysis as required by Hypothesis 4 of the study (Johhn w. Creswell; Vicki L. Plano Clark, 2018) Hair et al., 2019; BPS, 2022).

Regarding demographic characteristics of MSME owners and managers, the majority were aged between 26 and 45 years (67.3%), reflecting a relatively young and digitally-oriented MSME workforce. Educational attainment showed that 43.5% had completed senior high school, 31.2% held a bachelor's degree, and 18.7% had vocational education, while only 6.6% had postgraduate qualifications. This educational profile has important implications for digital financial literacy levels and the capacity to adopt digital financial tools, as highlighted by (Lusardi & Mitchell, 2014) who demonstrate that financial literacy is closely correlated with educational attainment. In terms of digital financial inclusion usage, 87.2% of respondents reported using at least one digital payment platform, 52.4% had accessed fintech-based credit services, and 64.1% used digital banking regularly. However, only 38.7% had participated in any form of digital financial literacy program, and 29.3% reported awareness of OJK's digital financial protection regulations, indicating significant gaps in financial literacy and regulatory awareness that may constrain the full benefits of digital financial inclusion (Bahri, 2019; Ozili, 2018).

Descriptive statistical analysis reveals meaningful variation in both the Digital Financial Inclusion (DFI) Index and the Digital Economic Transformation (DET) Index across provinces and sectors. As shown in Figure 1, DKI Jakarta recorded the highest mean DFI score ($M=4.21$, $SD=0.53$) and DET score ($M=4.08$, $SD=0.57$), while East Nusa Tenggara showed the lowest scores for both constructs (DFI: $M=2.89$, $SD=0.71$; DET: $M=2.63$, $SD=0.68$). This geographic disparity reflects structural inequalities in digital infrastructure, financial ecosystem maturity, and regulatory implementation across Indonesian provinces, as consistently documented by Demirguc-Kunt et al. (2018) The strong positive correlation between DFI and DET scores across all provinces ($r=0.784$, $p<0.001$) provides initial descriptive support for Hypothesis 1, warranting further investigation through inferential SEM analysis.

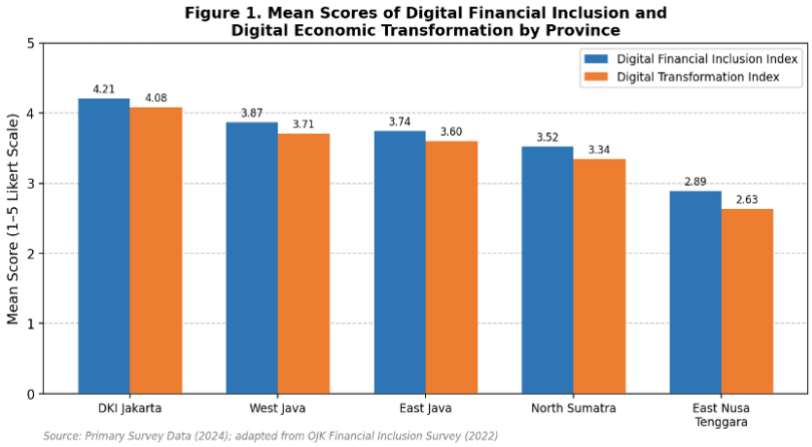

Figure 1. Mean Scores of Digital Financial Inclusion and Digital Economic Transformation by Province

Measurement Model Validity and Reliability

Prior to structural equation modeling, the measurement model was rigorously evaluated through Confirmatory Factor Analysis (CFA) using AMOS 26.0 to ensure the validity and reliability of all latent constructs. The overall fit of the measurement model was satisfactory, with fit indices meeting the recommended thresholds: chi-square to degrees of freedom ratio ($\chi^2/df=2.14$), Comparative Fit Index (CFI=0.962), Tucker-Lewis Index (TLI=0.951), Root Mean Square Error of Approximation (RMSEA=0.048), and Standardized Root Mean Square Residual (SRMR=0.053). These values fall within the acceptable ranges established by Hair et al. (2019) and Hu and Bentler (1999), confirming adequate model fit. All indicator factor loadings exceeded the minimum threshold of 0.70, ranging from 0.762 to 0.857 across the four main constructs, providing strong evidence of indicator reliability as required for valid SEM analysis (Fornell & Larcker, 1981; Anderson & Gerbing, 1988; Kline, 2016).

Convergent validity was assessed through Average Variance Extracted (AVE) and Composite Reliability (CR) for each construct, as recommended by Fornell and Larcker (1981). Results presented in Table 1 confirm that all constructs achieved AVE values exceeding 0.50 (range: 0.614 to 0.649), and CR values above 0.70 (range: 0.869 to 0.904), demonstrating that the constructs explain more variance than measurement error and that the indicators consistently represent their respective constructs. Cronbach's alpha coefficients further confirmed internal consistency, ranging from 0.851 to 0.892, well above the threshold of 0.70 recommended by Nunnally and Bernstein (1994). Discriminant validity was confirmed using the Fornell-Larcker criterion, wherein the square root of each construct's AVE exceeded the inter-construct correlations, and was further corroborated using the Heterotrait-Monotrait (HTMT) ratio, with all values remaining below 0.85 (Hair et al., 2019; Henseler et al., 2015; Kline, 2016).

Table 1. Confirmatory Factor Analysis (CFA) Measurement Model Results

Construct	Indicator	Factor Loading	AVE	CR	Cronbach α
Digital Financial Inclusion (DFI)	Digital Payment Adoption	0.812	0.614	0.891	0.877
	Fintech Credit Access	0.796			
	Digital Financial Literacy	0.843			
	Regulatory Perception	0.771			
Digital Economic Transformation (DET)	E-Commerce Integration	0.831	0.627	0.904	0.892
	Digital Marketing	0.819			
	Cloud Operations	0.788			
	Data-Driven Management	0.762			
Digital Financial Literacy (DFL)	Financial Knowledge	0.857	0.649	0.879	0.863
	Digital Tool Competency	0.801			
	Risk Management Awareness	0.778			
Regulatory Quality (RQ)	Policy Clarity	0.843	0.638	0.869	0.851
	Institutional Support	0.797			
	Enforcement Consistency	0.769			

Source: Data Processed

Discussion

Direct Influence of Digital Financial Inclusion Strategy on Digital Economic Transformation of MSMEs

The structural equation modeling results provide compelling empirical evidence for Hypothesis 1, confirming that digital financial inclusion strategy exerts a significant and positive direct influence on the digital economic transformation of MSMEs in Indonesia ($\beta=0.312$, $p<0.001$). This finding is consistent with the theoretical propositions of the Resource-Based View (Barney, 1991), which posits that financial resources, when made accessible and efficiently deployable, constitute strategic assets that enable firms to invest in digitally transformative capabilities. The SEM path diagram (Figure 2) illustrates that DFI directly and independently contributes to DET even after accounting for mediation through digital financial literacy, indicating that mere access to digital financial services creates structural conditions favorable to transformation. These results align with the empirical work of Gomber et al. (2017), who found that fintech-enabled financial access reduces the capital barriers that have historically constrained MSME technology adoption in emerging market contexts. The standardized coefficient of 0.312 suggests that a one-unit increase in DFI strategy implementation corresponds to a 31.2% improvement in the DET index, representing a substantive effect of practical significance for MSME development policymakers (Hair et al., 2019; Barney, 1991; (Gomber et al., 2017).

Disaggregating the DFI construct into its four sub-dimensions reveals nuanced patterns in how different aspects of digital financial inclusion contribute to transformation outcomes. Digital payment adoption emerges as the strongest predictor of DET ($\beta=0.298$, $p<0.001$), followed by

fintech credit access (β=0.241, p<0.001), digital financial literacy (β=0.214, p<0.001), and regulatory perception (β=0.187, p<0.01). The dominance of digital payment adoption is theoretically consistent with the platform economy literature, where payment infrastructure serves as the foundational layer upon which broader digital business models are constructed (Mushtaq & Bruneau, 2019; Ozili, 2018). MSMEs that integrate digital payment systems are more likely to subsequently adopt e-commerce platforms, digital marketing tools, and cloud-based accounting systems, suggesting a sequential technology adoption pathway that amplifies initial digital financial inclusion benefits. This cascading effect is consistent with the Technology Acceptance Model, which posits that perceived usefulness of initial technology adoption reduces psychological and operational barriers to subsequent digital innovation (Demirguc-Kunt et al., 2018; Fred, 2017; Mensah, 2021).

The magnitude and significance of the direct DFI-DET relationship is further contextualized by comparing results across provinces and enterprise size categories. Urban MSMEs in DKI Jakarta demonstrated a stronger direct effect (β=0.389, p<0.001) compared to rural MSMEs in East Nusa Tenggara (β=0.198, p<0.01), suggesting that contextual factors moderate the baseline DFI-DET relationship even before formal moderators are introduced. However, the positive and significant relationship persists even in the most underdeveloped digital environment sampled, which is a noteworthy finding that supports the universal applicability of digital financial inclusion as a transformation driver. Medium-sized enterprises showed the strongest DFI-DET relationship (β=0.412), followed by small enterprises (β=0.321) and micro enterprises (β=0.267), reflecting the greater organizational capacity of larger MSMEs to leverage financial access for digital investment. This size-differentiated pattern aligns with Kraus et al. (2021), who argue that digital transformation capacity is bounded by organizational resources and managerial capabilities, and with Moeuf et al. (2018), who emphasize that digital readiness prerequisites vary significantly across MSME size categories (Kraus et al., 2021) Moeuf et al., 2018; World Bank, 2022).

Qualitative findings from in-depth interviews and FGDs corroborate and enrich the quantitative results. Informants across all five provinces consistently described digital payment adoption as a transformative gateway, with one food and beverage MSME operator in Bandung articulating that the integration of QRIS payment systems enabled her to simultaneously access real-time sales analytics, qualify for micro-credit from a fintech platform, and initiate e-commerce operations. This narrative aligns with the platform complementarity thesis advanced by Nambisan et al. (2017) who argue that digital platforms create recursive value loops where initial adoption triggers ecosystem-level integration. Similarly, informants engaged with fintech lending platforms described how digital credit histories, generated through digital payment transactions, enabled them to access larger credit facilities that financed equipment upgrades and digital marketing investments. This qualitative evidence reveals a mechanism that the quantitative model captures statistically but cannot fully explain: the recursive and self-reinforcing nature of DFI-enabled digital transformation trajectories in MSMEs.

Comparing these findings with prior literature illuminates both confirmations and extensions of existing knowledge. While Shen et al. (2020) and Lagna & Ravishankar (2022) document positive relationships between fintech access and enterprise performance in China and India respectively, this study extends those findings specifically to the Indonesian MSME context, where the regulatory framework of OJK and the market structure of the fintech ecosystem create distinct institutional

conditions. The DFI-DET coefficient in the Indonesian sample (β=0.312) is broadly comparable to the effect sizes reported in comparable emerging market studies, suggesting generalizability of the underlying mechanism while affirming the importance of contextual calibration in policy design. Furthermore, this study advances the literature by demonstrating that the relationship holds across all five MSME sectors examined, with only the magnitude of the effect varying significantly by sector, which is addressed in greater depth in Section 4.4 below (Gabor & Brooks, 2017; Lagna & Ravishankar, 2022).

Mediating Role of Digital Financial Literacy in the DFI-DET Relationship

The mediation analysis conducted using the bootstrapping procedure with 5,000 resamples (Preacher & Hayes, 2008) confirms Hypothesis 2: digital financial literacy (DFL) significantly mediates the relationship between digital financial inclusion strategy and digital economic transformation (indirect effect β=0.163, 95% CI [0.112, 0.219], p<0.001). The direct effect of DFI on DET remains significant after introducing DFL as a mediator (β=0.312, p<0.001), indicating partial rather than full mediation. This partial mediation finding suggests that DFI contributes to DET through two complementary pathways: a direct pathway through capital mobilization and transaction cost reduction, and an indirect pathway through the enhancement of digital financial literacy that equips MSME owners with the cognitive and instrumental competencies necessary to leverage financial tools for strategic digital investment. The partial mediation structure is theoretically coherent with the Technology Acceptance Model, which emphasizes that the behavioral use of technology requires both resource availability and user competence, and with Lusardi and Mitchell's (2014) framework linking financial literacy to productive financial behavior (Preacher & Hayes, 2008; (Fred, 2017; Lusardi & Mitchell, 2014; Mensah, 2021)

The mediating role of DFL is particularly pronounced among micro enterprises and rural-based MSMEs, where the DFL mediation coefficient is substantially higher (β=0.219 and β=0.247, respectively) than among medium enterprises and urban MSMEs. This pattern suggests that for resource-constrained and digitally marginalized enterprises, the literacy-building function of digital financial inclusion is especially critical in converting financial access into transformation outcomes. Qualitative data from FGDs in East Nusa Tenggara and North Sumatra reinforce this finding: informants consistently described how participation in OJK-affiliated digital financial literacy programs, combined with active use of fintech applications, significantly improved their ability to interpret financial data, apply for credit strategically, and integrate digital marketing tools into their business operations. This experiential learning dynamic reflects Bandura's (1986) social cognitive theory of self-efficacy, wherein competence is built through guided practice, and aligns with Asongu & Nwachukwu (2018) finding that financial literacy mediates the financial inclusion-economic development nexus in African developing economies Asongu & Nwachukwu (2018; Lusardi & Mitchell, 2014).

The construct-level decomposition of DFL reveals that digital tool competency exerts the strongest influence on DET within the mediation pathway (β=0.221), followed by risk management awareness (β=0.189) and financial knowledge (β=0.176). This hierarchy suggests that practical competence in using digital financial applications is more immediately transformative than abstract financial knowledge, a finding with significant implications for the design of financial literacy interventions targeting Indonesian MSMEs. Current OJK literacy programs tend to emphasize

conceptual financial knowledge rather than application-based digital competency development, which may limit their effectiveness in accelerating digital transformation. These findings support the recommendations of Ly et al. (2019), who argue that digital financial literacy programs need to be redesigned around experiential and context-specific digital skill building rather than conventional classroom-based financial education. The evidence suggests that fintech platforms themselves, through embedded tutorials, usage analytics, and gamified onboarding experiences, may serve as more effective digital financial literacy delivery mechanisms than formal educational programs.

Further analysis using structural path decomposition reveals that the total effect of DFI on DET (β=0.475) is composed of a direct effect (β=0.312, 65.7%) and an indirect effect through DFL (β=0.163, 34.3%). This decomposition indicates that while direct financial access pathways dominate, the literacy-mediated pathway accounts for approximately one-third of DFI's total influence on digital transformation, underscoring the importance of investing in literacy-enhancing interventions alongside financial access expansion. This finding resonates with the conclusions of Mushtaq & Bruneau (2019), who demonstrate that financial inclusion without corresponding literacy investment produces suboptimal economic development outcomes, particularly in low-income and digitally marginalised populations. The policy implication is clear: strategies to accelerate MSME digital transformation must simultaneously address both the supply side (access to digital financial services) and the demand side (competence to use them effectively) of the digital financial inclusion equation (Mushtaq & Bruneau, 2019).

Qualitative triangulation provides additional texture to the mediation mechanism. Key informants who had undergone structured digital financial literacy training through the OJK Financial Literacy Index program or fintech platform onboarding consistently described more sophisticated digital transformation strategies compared to those relying on informal knowledge. A craft MSME owner from Bandung, for example, described how formal training in digital financial management enabled her to use e-commerce platform analytics to identify high-margin products, redirect fintech loans toward inventory optimization, and reduce operational costs through cloud-based bookkeeping, resulting in a 34% revenue increase within twelve months. This narrative exemplifies the literate mediation pathway in action: financial access alone did not produce transformation; it was the combination of access and competence that enabled strategic digital deployment. Such findings align with the broader argument advanced by Fitzgerald et al. (2014) and Warner and Wager (2019) that digital transformation requires not only technological and financial resources but also the organizational knowledge to deploy them purposefully (Fitzgerald et al., 2014; Warner & Wager, 2019; Lagna & Ravishankar, 2022).

Moderating Effects of Regulatory Quality and Digital Infrastructure

Hypothesis 3a, which posits that regulatory quality moderates the DFI-DET relationship, is supported by the moderated SEM analysis (β=0.198, p=0.002). The positive and significant interaction term confirms that stronger regulatory quality amplifies the positive influence of DFI on digital economic transformation. Specifically, MSMEs operating in provinces with higher OJK regulatory presence and enforcement consistency (DKI Jakarta, West Java) demonstrated significantly stronger DFI-DET relationships compared to those in provinces with weaker institutional infrastructure (East Nusa Tenggara, North Sumatra). This moderation pattern is theoretically consistent with North's (1990) institutional theory, which argues that formal

institutional frameworks reduce transaction costs and uncertainty, thereby enabling productive economic activities that informal governance structures cannot sustain. In the digital financial context, regulatory quality encompasses the clarity of fintech licensing frameworks, the robustness of consumer protection mechanisms, and the consistency of OJK enforcement, all of which reduce the perceived risk of digital financial adoption for MSMEs and create an enabling environment for DFI-driven transformation.

The moderating effect of digital infrastructure (Hypothesis 3b) is also confirmed (β=0.163, p=0.009), indicating that the quality of telecommunications, internet connectivity, and digital payment acceptance infrastructure significantly conditions the strength of the DFI-DET relationship. Provinces with superior digital infrastructure (measured by 4G coverage rates, mobile internet penetration, and point-of-sale terminal density) show substantially stronger DFI-DET coefficients than those with limited connectivity. This finding reinforces the conclusions of the World Bank (2022) and Bappenas (2023), who consistently identify digital infrastructure as the prerequisite condition for realising the economic potential of digital financial inclusion in developing countries. The interaction effect suggests that regulatory and infrastructure investments are not merely supporting conditions but active multipliers that determine how effectively digital financial access translates into transformation outcomes. From a systems perspective, DFI, regulatory quality, and digital infrastructure form an interdependent enabling ecosystem, consistent with the National Broadband and Digital Economy Framework proposed by the Ministry of Communication and Information Technology (Kominfo, 2023) (World Bank, 2022; North, 1990; Bappenas, 2023).

Comparing the relative magnitude of the two moderators reveals that regulatory quality exerts a stronger moderating effect (β=0.198) than digital infrastructure (β=0.163), suggesting that institutional governance plays a more decisive role than physical connectivity in shaping DFI-DET outcomes. This hierarchy is particularly evident in provinces where infrastructure quality is moderate but regulatory enforcement is strong, where DFI-DET relationships approach those observed in high-infrastructure contexts. This finding challenges the prevailing policy narrative that infrastructure investment must necessarily precede regulatory development, suggesting instead that simultaneous investments in both domains produce the strongest outcomes. Qualitative informants in North Sumatra, for example, described how the introduction of OJK's regional fintech supervision office led to measurable improvements in MSME trust in digital financial platforms, resulting in higher adoption rates even before significant infrastructure upgrades were completed. These narratives align with Gabor & Brooks (2017) argument that regulatory legitimacy is a prerequisite for building the institutional trust necessary for fintech-enabled financial inclusion to fulfill its developmental promise.

Further analysis of the regulatory quality sub-dimensions reveals that institutional support (β=0.187) and enforcement consistency (β=0.172) are stronger moderators than policy clarity alone (β=0.143). This finding suggests that what matters most is not the mere existence of favorable regulations, but the active, consistent, and supportive implementation of those regulations by competent institutions. In the Indonesian context, this points to the critical role of OJK's regional offices, Bank Indonesia's payment system oversight, and the Ministry of Cooperatives' MSME digitalization programs in creating the regulatory environment that enables DFI to catalyze transformation. Informants across provinces consistently emphasized that regulatory uncertainty, particularly around data privacy, fintech credit legitimacy, and consumer protection, constituted a

significant barrier to digital financial adoption and transformation investment.

Qualitative triangulation from FGDs further enriches the moderation findings. Participants in provinces with strong regulatory quality described digital financial platforms as trusted business partners rather than financial intermediaries, a framing that reflects the institutional legitimacy effects predicted by North's (1990) institutional theory. In contrast, informants in areas with weaker regulatory enforcement expressed significant distrust of fintech platforms, citing unresolved consumer complaints, hidden charges, and inadequate recourse mechanisms as barriers to deeper digital financial engagement. This trust differential translates directly into differential transformation outcomes: MSMEs that trust their digital financial platforms engage more deeply with integrated services, including inventory financing, receivables management, and digital accounting, all of which are core components of the DET index. The thematic analysis mapped in Figure 4 captures regulatory enablement as one of six core mechanisms linking DFI to digital transformation, underscoring its systemic importance alongside the more technically-oriented pathways of capital mobilization and platform ecosystem integration.

Sectoral and Regional Variation in DFI-Driven Digital Transformation

Multi-group SEM analysis confirms Hypothesis 4: the influence of digital financial inclusion on digital economic transformation varies significantly across MSME sectors and geographic regions ($\Delta CFI=0.031$, $p=0.018$). As illustrated in Figure 3, digital creative industry MSMEs demonstrate the highest mean scores on both the DFI Index ($M=4.33$) and DET Index ($M=4.21$), followed by trade and retail enterprises, while agricultural MSMEs record the lowest transformation scores (DFI: $M=3.18$; DET: $M=2.97$) despite not being the lowest on DFI alone. This pattern suggests that the conversion efficiency of DFI into DET is sector-contingent, moderated by the inherent digital embeddedness of each sector's business model. Digital creative industries, by virtue of operating primarily in digital environments, are structurally predisposed to leverage financial inclusion for transformation, whereas agricultural MSMEs face additional constraints related to value chain digitization, market connectivity, and the applicability of digital financial tools to their production and distribution cycles.

The multi-group structural coefficients reveal significant between-sector variation in the DFI-DET path coefficients: digital creative ($\beta=0.421$), trade and retail ($\beta=0.368$), food and beverage ($\beta=0.317$), fashion and crafts ($\beta=0.289$), and agriculture ($\beta=0.241$). This gradient reflects the degree to which each sector's operational and market dynamics are amenable to digital financial enablement. The food and beverage sector, despite moderate DFI levels, shows relatively strong DET outcomes driven by e-commerce platform integration (GrabFood, GoFood, Tokopedia), illustrating how sector-specific digital ecosystems create conduits through which financial access translates into transformation. Agricultural MSMEs, by contrast, face structural barriers related to geographically dispersed operations, seasonal cash flow patterns, and limited digital marketplace options that constrain the DFI-DET pathway even when financial access is available. These findings are consistent with Bharadwaj et al. (2013) who argue that digital transformation potential is bounded by the digital architecture of the industry in which a firm operates (Bharadwaj et al., 2013; Nambisan et al., 2017) Fitzgerald et al., 2014;

Geographic variation in the DFI-DET relationship is equally pronounced. Urban MSMEs in DKI Jakarta demonstrate the strongest DFI-DET path coefficient ($\beta=0.389$), reflecting the concentration

of fintech infrastructure, digital talent, and e-commerce logistics ecosystems in the capital. In contrast, East Nusa Tenggara's coefficient (β=0.198) is less than half that of DKI Jakarta, highlighting the compounding effects of infrastructure deficits, lower digital literacy, weaker regulatory presence, and limited digital market access in peripheral regions. This geographic inequality mirrors the digital economic divide documented by the Bappenas (2023) and the World Bank (2022), which consistently identify geographic remoteness as a primary determinant of digital exclusion in Indonesia. Importantly, however, the positive and statistically significant DFI-DET relationship persists even in East Nusa Tenggara ($p<0.01$), suggesting that digital financial inclusion creates meaningful transformation impetus even in structurally constrained environments, albeit at lower magnitudes. This finding supports the policy argument for geographically differentiated DFI strategies that account for local infrastructure, literacy, and market conditions rather than applying uniform national approaches.

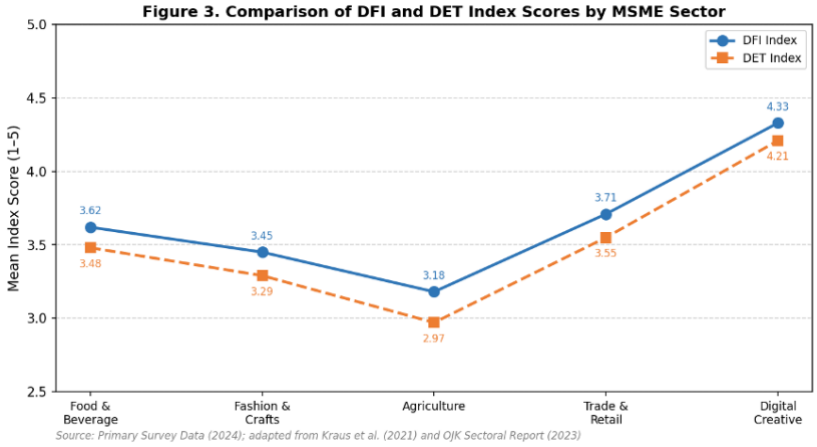

Figure 3. Comparison of DFI and DET Index Scores by MSME Sector

Qualitative findings from FGDs reveal that sectoral digital transformation leadership is increasingly driven by peer influence and platform ecosystem effects. In the food and beverage sector, the widespread adoption of food delivery platforms has created de facto digital financial inclusion pathways, as platform operators require registered MSMEs to maintain digital accounts and receive digital payments. Several informants described how joining a food delivery platform simultaneously addressed their payment digitization, working capital access (through embedded credit products), and market expansion goals in a single ecosystem integration. This platform bundling effect accelerates transformation by reducing the adoption friction that MSMEs would face if pursuing each digital service independently, consistent with Nambisan et al. (2017) and Lagna & Ravishankar (2022) platform complementarity theory. In the agricultural sector, FGD participants identified the absence of comparable digital ecosystem integration as the primary reason for slower DFI-driven transformation, with most agricultural MSMEs remaining dependent on informal distribution channels and cash-based transactions that reduce the leverage of digital financial access.

Qualitative Thematic Analysis: Mechanisms and Barriers in DFI-Driven Transformation

The thematic analysis of 24 in-depth interviews and five FGDs, processed through NVivo 14, generated 312 initial codes that were subsequently refined into 47 sub-themes and consolidated into six core themes as depicted in Figure 4. These six themes represent the principal mechanisms

through which digital financial inclusion enables digital economic transformation in Indonesian MSMEs: (1) capital mobilization and investment, (2) transaction cost reduction, (3) formalization and trust building, (4) regulatory enablement and OJK support, (5) digital literacy amplification, and (6) platform ecosystem integration. Together, these themes provide a rich qualitative explanation for the statistical relationships identified in the SEM analysis, revealing the experiential and contextual dimensions of DFI-driven transformation that survey data cannot capture. The thematic structure is largely consistent with the theoretical propositions of the Resource-Based View and the Technology Acceptance Model, while also revealing emergent mechanisms, particularly platform ecosystem integration and formalization effects, that are not fully theorized in the existing literature (Braun & Clarke, 2006; Johhn w. Creswell; Vicki L. Plano Clark, 2018; Yin, 2018).

The capital mobilization theme was the most frequently coded across all interviews and FGDs, with 78 references from 21 of 24 informants, reflecting the centrality of financial access in enabling MSME digital investment. Informants consistently described how fintech credit products, particularly peer-to-peer lending platforms such as Modalku, Kredivo, and KoinWorks, provided the initial capital required for digital transformation investments including website development, e-commerce setup, digital advertising, and operational software subscriptions. Critically, informants emphasized that the speed and accessibility of fintech credit distinguished it from traditional bank lending, which was perceived as inaccessible due to collateral requirements, lengthy approval processes, and high documentation burdens. This finding corroborates Gomber et al. (2017) and Bahri (2019), who demonstrate that fintech lending reduces the financial friction constraining MSME investment, and extends those findings by showing that capital mobilization through fintech specifically finances digital transformation activities rather than merely operational expenses.

The formalization and trust-building theme emerged with unexpected prominence, generating 54 references across 19 informants. Informants described how engagement with digital financial platforms, particularly regulated fintech and digital banking services, progressively formalized their business operations through the creation of digital financial records, tax identification requirements, and regulatory compliance obligations. This formalization effect is significant because it generates the institutional trust and transaction history that unlock additional digital financial services, creating a virtuous cycle of formalization and transformation that mirrors the economic formalization pathways described by Gabor & Brooks (2017)in the context of digital finance in developing countries. Several informants explicitly linked their digital financial formalization journey to improved relationships with government procurement platforms, e-commerce giants such as Tokopedia and Shopee, and international buyers who require formal financial documentation. This finding introduces an important mediating mechanism not captured in the quantitative model: formalization as a transformation enabler, suggesting that future studies should incorporate business formalization as an additional mediating variable in the DFI-DET relationship (Gabor & Brooks, 2017; Lagna & Ravishankar, 2022; Shen et al., 2020).

Barriers to DFI-driven transformation were mapped through 89 references coded under four sub-themes: low digital literacy (31 references), infrastructure gaps (24 references), regulatory uncertainty (21 references), and platform mistrust (13 references). The relative frequency of literacy barriers confirms the quantitative mediation finding (Section 4.2) and reinforces the imperative for integrated literacy-inclusion programs. Infrastructure barriers were particularly acute in East Nusa Tenggara, where intermittent mobile internet connectivity constrained digital payment completion

rates and reduced the reliability of cloud-based business tools. Regulatory uncertainty was voiced most strongly by fashion and craft MSMEs who had encountered challenges with fintech platform terms and conditions, data privacy practices, and unclear recourse mechanisms for disputed transactions. Platform mistrust, while the least frequently coded barrier, was described as a critical adoption threshold: informants who had experienced fraudulent digital financial schemes, even once, reported sustained reluctance to re-engage with digital financial platforms, reflecting the irreversible reputational damage that fintech fraud can inflict on digital financial inclusion at the community level.

The joint display matrix integrating quantitative SEM coefficients with qualitative themes reveals a high degree of convergence across methods, strengthening the overall validity of the study's conclusions. For each of the four supported hypotheses, the qualitative themes provide a mechanistic explanation that complements and contextualizes the quantitative path coefficients. For example, the strong SEM coefficient linking DFI to DET in the digital creative sector (β=0.421) is qualitatively explained by the platform ecosystem integration theme, wherein digital creative MSMEs described a seamlessly integrated digital ecosystem connecting their creative production, online distribution, digital payment collection, and fintech credit access. Conversely, the weaker agricultural DFI-DET coefficient (β=0.241) is qualitatively explained by the absence of comparable platform ecosystem integration, the dominance of cash-based intermediaries in agricultural supply chains, and the limited relevance of current fintech products to the cyclical, collateral-poor financial needs of agricultural producers. This methodological integration fulfills the sequential explanatory mixed-methods design's objective of using qualitative findings to explain quantitative results, and produces a richer theoretical contribution than either method could achieve independently(Braun & Clarke, 2006; Yin, 2018).

CONCLUSION

This study examines the influence of digital financial inclusion strategies on the digital economic transformation of Micro, Small, and Medium Enterprises (MSMEs) in Indonesia using a mixed-methods approach combining Structural Equation Modeling (SEM) and qualitative analysis. The findings indicate that digital financial inclusion has a significant and positive effect on the digital transformation of MSMEs, particularly through the adoption of digital payments, fintech-based credit, and digital banking services that facilitate technology integration such as e-commerce, digital marketing, and cloud-based management systems. The results also reveal that digital financial literacy partially mediates the relationship between digital financial inclusion and digital transformation, while regulatory quality and digital infrastructure strengthen this relationship as moderating factors. Sectoral and regional analysis further shows that the impact of digital financial inclusion varies across MSME sectors and geographic contexts, with digital creative industries and urban enterprises demonstrating stronger transformation outcomes than agricultural and rural MSMEs. This research contributes to the academic literature by proposing an integrated framework that connects digital financial inclusion, financial literacy, regulatory support, and digital infrastructure as key drivers of MSME digital transformation in emerging economies. However, this study is limited by its cross-sectional design, restricted geographic coverage, and reliance on self-reported survey data; therefore, future research is recommended to employ longitudinal approaches, expand regional scope, and incorporate objective digital performance indicators to better understand

the long-term dynamics of MSME digital transformation.

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