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Technology adoption as a pathway to financial inclusion in the digital economy: A study of Indonesian SME's

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ABSTRACT

Financial inclusion remains a pressing challenge for Indonesian MSMEs, with nearly 70% of enterprises still facing limited access to formal financial services. In the era of rapid digital transformation, the digital economy presents an opportunity to reduce this gap by enabling broader access through technology-driven platforms. This study aims to examine the influence of the digital economy on financial inclusion, as well as to investigate the mediating role of technology adoption based on the Technology Acceptance Model (TAM). Utilizing a quantitative research design, data were collected through a validated questionnaire from 350 MSME actors in Sukabumi, Indonesia. Structural Equation Modeling using Partial Least Squares (SEM-PLS) was applied to analyze both the measurement and structural models. The results reveal that the digital economy significantly affects both financial inclusion and technology adoption. Furthermore, technology adoption has a positive and significant impact on financial inclusion, and also serves as a partial mediator between the digital economy and financial inclusion. These findings underscore the critical role of behavioral acceptance in the successful implementation of digital financial services. This study contributes to the development of an integrated framework that combines structural and behavioral perspectives, offering practical insights for policymakers and digital service providers aiming to foster inclusive economic growth through technology-driven financial access.

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1. INTRODUCTION

The advancement of the digital economy has transformed the global economic landscape by introducing new paradigms in the production, distribution, and consumption of goods and services. In developing countries such as Indonesia, this transformation presents both opportunities and challenges, particularly for the micro, small, and medium enterprises (MSMEs) sector, which serves as the backbone of the national economy.

Despite its critical role in job creation and poverty reduction, MSME financial inclusion remains low—only about 30% of Indonesian MSMEs have access to formal financial services. This reality hinders the ability of MSME actors to access financing, government stimulus, and other developmental support programs, ultimately limiting their economic resilience and growth potential (Kumar Chaudhary, Mani Ghimire, et al., 2024; Paliwal, 2024). The empirical urgency of this study arises from persistently low MSME financial inclusion, with nearly 70% lacking access to formal financial services despite rapid digital expansion. This persistent gap indicates that digital progress has not translated into effective financial participation. Therefore, understanding the structural and behavioral barriers that hinder MSME engagement is essential.

Financial inclusion, as regulated in the Indonesian Financial Services Authority Regulation No. 76/POJK.07/2016, is defined as the availability of access to a range of financial institutions, products, and services tailored to the needs and capabilities of the community, aimed at improving public welfare. In this context, financial inclusion is not only a means to reduce economic inequality but also a key policy pillar in increasing national added value. Financial inclusion is the process of ensuring the provision of sustainable financial products and services to low-income groups at costs that are affordable, fair, and transparent. (Bhaskar, 2013). The challenge in designing an inclusive financial ecosystem lies in the high costs associated with opening and maintaining a large number of accounts, combined with remote locations, which translate into issues of affordability and financial inaccessibility. (Karpowicz, 2016). Therefore, a hybrid approach is required, combining regulatory policies with institutional innovation, structural improvisation, and the accelerated adoption of digital technologies. (Aggarwal & Klapper, 2013) (Demirgüç-Kunt & Klapper, 2013). The acceleration of the digital economy—characterized by the widespread use of mobile technology, digital platforms, and online payment systems—has the potential to bridge the financial divide and enhance the participation of MSMEs in the formal financial system (Thathsarani & Jianguo, 2022).

Although digital financial services are increasingly available, their adoption among MSMEs remains uneven. Several empirical studies show that the mere availability of digital tools does not guarantee their effective utilization if user acceptance factors are not addressed (Vyas & Jain, 2021a). The Technology Acceptance Model (TAM) offers a relevant theoretical framework to explain this phenomenon by emphasizing perceived ease of use, usefulness, credibility, and self-efficacy as key predictors of technology adoption behavior. Understanding how these factors mediate the relationship between the digital economy and financial inclusion is essential for designing effective policy interventions and technological solutions (Lucian Dimoso & Utonga, 2024).

This study, therefore, seeks to explore the effect of the digital economy on financial inclusion among MSMEs, while examining the mediating role of technology adoption based on TAM. The central research questions are as follows: (1) Does the digital economy influence financial inclusion? (2) Does the digital economy influence technology adoption? and (3) Does technology adoption influence financial inclusion? Addressing these questions is critical for building a more holistic understanding of the mechanisms that drive inclusive finance in the digital age.

By integrating the digital economy and TAM frameworks in the context of Indonesian MSMEs, this research provides a novel contribution to both theory and practice. It responds to the current research gap by offering empirical evidence on how behavioral factors mediate structural economic changes. Moreover, the study adds value by highlighting the importance of designing digital solutions that are not only technologically robust but also aligned with users' needs, capacities, and attitudes.

The foundation of this study rests upon three central theoretical constructs: the digital economy, technology adoption, and financial inclusion. The digital economy refers to economic activities facilitated by digital technologies, especially internet-based

platforms, mobile applications, and cloud computing, which collectively enable new forms of business models, transactions, and services. It encompasses dimensions such as business model innovation, user awareness, customer value proposition, and the supporting digital infrastructure (Vyas & Jain, 2021a). Technology adoption, as conceptualized through the Technology Acceptance Model (TAM), emphasizes five key indicators: perceived ease of use, perceived usefulness, perceived credibility, perceived self-efficacy, and user attitude. (Khattak et al., 2021). This model provides a robust lens to understand how individuals and organizations accept and utilize new technologies. Financial inclusion, meanwhile, is defined as the availability and effective use of affordable financial services to all segments of society, especially those underserved, in a manner aligned with their needs and capabilities (Gunawan & Somantri, 2023) .

Prior studies have underscored the role of the digital economy in enhancing financial access for SMEs and marginalized communities. For instance, Chaudhary et al. (2024) highlight that digital banking significantly promotes inclusive financial services in developing economies (Kumar Chaudhary, Mani Ghimire, et al., 2024), while Hanshika and Wijekumara (2024) identify digital financial literacy as a critical determinant in MSME engagement with financial services (Aniqoh, 2020); (Hanshika & Wijekumara, 2024). Similarly, Dimoso and Utonga (2024) reveal that despite the availability of technology, adoption remains uneven across SME sectors due to perceived barriers (Lucian Dimoso & Utonga, 2024). Studies by Thathsarani and Jianguo demonstrate how the TAM model effectively captures consumer behavior in digital financial environments, especially in emerging markets (Thathsarani & Jianguo, 2022).

Despite the growing number of studies, a critical gap persists in understanding the interplay between digital economic constructs, TAM-based adoption behavior, and financial inclusion in an integrated framework, particularly within the Indonesian MSME context. Most research treats these constructs in isolation, rarely accounting for the mediating mechanisms through which digital transformation translates into financial accessibility. For example, Paliwal (2024) underscores mobile banking as a vital tool for financial inclusion but does not explore the behavioral aspects influencing its adoption (Paliwal, 2024). Likewise, Yu (2024) focuses on rural businesses but omits technology acceptance variables (Yu, 2024). This limitation reduces the explanatory power of previous studies in formulating effective digital financial strategies for MSMEs.

Prior studies examine digital economy, TAM, and financial inclusion separately, resulting in conceptual fragmentation. No existing research integrates these constructs into a unified empirical model for MSMEs. This study fills that gap by combining structural and behavioral variables within a single framework.

Positioning itself within this gap, the current study aims to bridge the theoretical disconnection by integrating constructs of the digital economy and TAM into a unified empirical model that explains financial inclusion outcomes. This model reflects the need for a nuanced understanding of both structural and behavioral determinants of digital financial access among MSMEs. By doing so, the study not only offers a fresh perspective on digital transformation but also contributes to refining theories of technology acceptance in financial contexts.

Furthermore, recent literature reflects varying theoretical and methodological approaches to these themes. Some studies, such as those by Vyas and Jain (2021), employ conceptual analysis to link digital strategies with inclusive finance (Vyas & Jain, 2021a), while others like Daud and Ahmad (2022) use econometric models to assess the macro-level impact of digital infrastructure (Daud & Ahmad, 2023). Umar et al. (2024) adopt a cross-country analysis, providing insight into regional digital disparities but lacking behavioral granularity (Umar et al., 2024a). These diverse methodologies underscore the need for integrative and context-sensitive models.

2. RESEARCH METHOD

This study employs a quantitative research design aimed at examining the causal relationships among digital economy, technology adoption, and financial inclusion within the context of micro, small, and medium-sized enterprises (MSMEs). The research adopts a structured explanatory approach to test the theoretical model developed based on the Technology Acceptance Model (TAM) and digital economy indicators. The primary objective is to analyze both the direct and indirect effects between variables using a field-based method supported by validated empirical data.

The data used in this study are primary in nature, collected directly from the research subjects through a questionnaire. The questionnaire was designed based on established indicators and has undergone rigorous testing to ensure validity and reliability. Respondents were selected from MSME actors operating in the city of Sukabumi, with a total population of 30,428 businesses. Using purposive sampling techniques, 350 MSME owners or managers were selected as the research sample to represent various business sectors proportionally and adequately.

The data collection technique involved the distribution of structured questionnaires, which consisted of closed-ended items measured using a Likert scale. The instrument was developed to measure three latent variables: digital economy (with indicators such as business models, awareness, customer value proposition, and infrastructure), technology adoption (measured through perceived ease of use, perceived usefulness, perceived credibility, perceived self-efficacy, and attitude), and financial inclusion (covering aspects of access, usage, and quality of financial services). The survey was administered face-to-face and digitally to ensure coverage and accuracy of responses.

To ensure the quality of data, inclusion criteria included MSME actors with at least one year of business operation and active use of digital platforms in either business operations or financial transactions. Enterprises with incomplete data, informal or seasonal operations, or no engagement with digital tools were excluded. These criteria helped ensure that the sample aligned with the study's focus on technology adoption in a digitally transforming economy.

The unit of analysis in this research is the individual MSME business owner or decision-maker, as they are directly involved in adopting and implementing digital tools and financial services. This unit allows the analysis to capture perceptions and behaviors relevant to the TAM framework and financial inclusion dynamics.

The analytical technique used is Structural Equation Modeling with Partial Least Squares (SEM-PLS), a method suitable for complex model testing involving multiple latent variables and mediation effects. The analysis was conducted using SmartPLS 4 software, which facilitated both the measurement model (confirmatory factor analysis) and the structural model (hypothesis testing). SEM-PLS was chosen for its ability to handle non-normal data distributions, small-to-medium sample sizes, and reflective-formative construct relationships. This technique also allows the evaluation of the model's predictive power and the significance of direct and indirect effects, providing robust insights into the proposed theoretical model. The selected indicators are grounded in validated frameworks: digital economy constructs from Vyas & Jain (2021), TAM variables from Davis's established model, and financial inclusion indicators from OJK and global standards. These measures ensure conceptual rigor and empirical comparability across MSME studies. Their integration enables a comprehensive model capturing structural and behavioral determinants.

To support the methodological rigor, this approach is in line with contemporary research in digital transformation and SME studies, where SEM-PLS is frequently used to examine mediation effects and complex variable interactions (Hu et al., 2023), (Sinaga et al., 2023). This methodological choice ensures both theoretical alignment and empirical validity in testing the relationships hypothesized in this study.

3. RESULTS AND DISCUSSIONS

3.1 Outer Model

The results of the quantitative analysis using the Partial Least Squares Structural Equation Modeling (SEM-PLS) approach reveal several significant findings that align with the research objectives and hypotheses. The measurement model analysis indicates that most indicators used to measure latent variables—Digital Economy, Technology Adoption, and Financial Inclusion met the minimum threshold of 0.70 for factor loading, which indicates acceptable convergent validity. One indicator, User Awareness (0.568), was removed due to its low loading score. After removal, re-evaluation (Hair et al., 2019) (Table 1 and Figure 1)) showed that all indicators had factor loadings ≥ 0.70.

Table 1: Statistic Measurement Model

	Digital Economy	Financial Inclusion	TAM
CVP	0.873		
FS		0.929	
Innovation	0.887		0.821
PQS		0.812	0.801
Perceived Credibility			0.845
Perceived Ease of Use			0.745
Perceived Self-Efficacy			0.821
Perceived Usefulness			0.809
UPS		0.821	
User Attitude			0.930

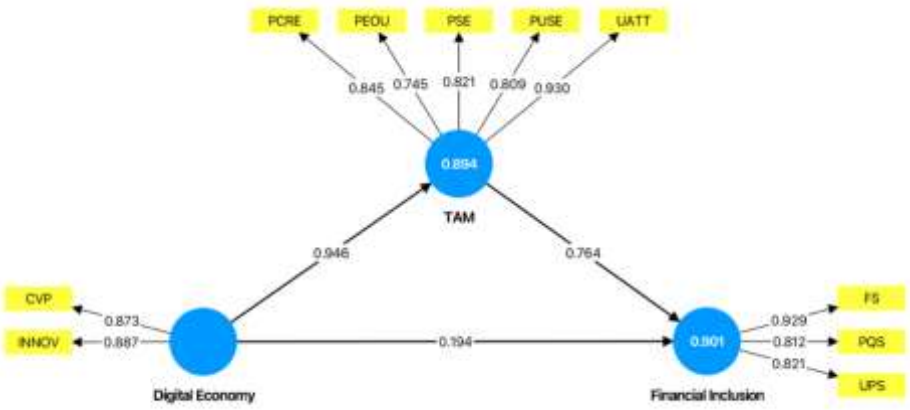

Figure 1 : Measurement Model

3.2 Discriminant validity test are using the Fornell-Larcker Criterion.

The results of the discriminant validity test are presented in Table 2 using the Fornell-Larcker Criterion. The correlations among constructs demonstrate that all square root values of AVE were higher than the inter-construct correlations, confirming discriminant validity (Hair et al., 2021). For example, the correlation between Digital Economy and Technology Adoption was 0.946, yet the correlation of each construct with itself (i.e., the diagonal values) was higher, namely 0.880 for Digital Economy, 0.832 for TAM, and 0.856 for Financial Inclusion.

Tabel 2: Discriminant Validity

	Digital Economy	Financial Inclusion	TAM
Digital Economy	0.880		
Financial Inclusion	0.916	0.856	

TAM	0.946	0.947	0.832

3.3 Reliability and Average Variance Extracted (AVE)

All constructs achieved satisfactory levels of internal consistency and reliability, with Cronbach's alpha ≥ 0.70, composite reliability (rho_c) ≥ 0.70, and AVE ≥ 0.50.

Table 3: Reliability

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Digital Economy	0.710	0.712	0.873	0.775
Financial Inclusion	0.814	0.820	0.891	0.732
TAM	0.888	0.898	0.918	0.692

These results indicate strong reliability and convergent validity of the constructs in the model.

3.4 Inner Model

a. Collinearity

All Variance Inflation Factor (VIF) values were below the critical value of 5 (Table 4), suggesting that multicollinearity was not an issue in the structural model.

Table 4. Colinearity Test

	VIF
CVP	1.435
FS	2.931
Innovation	1.435
PQS	1.884
Perceived Credibility	2.724
Perceived Ease of Use	1.697
Perceived Self-Efficacy	2.328
Perceived Usefulness	2.219
UPS	1.898
User Attitude	4.532

b. R Square

The R-square values demonstrate the explanatory power of the model: According to Chin (1998), R^2 values above 0.67 are considered substantial, indicating that the model explains a large portion of the variance in both dependent variables.

Table 5. Coeficient Determination

	R-square	R-square adjusted
Financial Inclusion	0.901	0.900
TAM	0.894	0.894

3.5 Hypothesis testing

Hypothesis testing was conducted using the bootstrapping method with 5,000 subsamples. The results are shown in Table 6 as follows:

Table 6 : Hypothesis Result Test

Hypothesis	T Statistic	P Values	Hypothesis Support
Digital Economy -> Financial Inclusion	3.710	0.000	Yes
Digital Economy -> TAM	198.236	0.000	Yes
TAM -> Financial Inclusion	15.096	0.000	Yes

All three hypotheses proposed in this study were supported by empirical data, with significance values below 0.001 and T-statistics far above the minimum threshold of 1.96, indicating statistically significant relationships among the constructs (Rigdon, 2016). These results suggest that the Digital Economy has a direct and significant effect on financial inclusion, as well as an indirect effect through the mediating variable of Technology Adoption. This is supported by other studies showing that digital technology enhances MSMEs' financial access when the technology is properly accepted and utilized by end users (Verma & Shome, 2025); (Kumar Chaudhary, Mani Ghimire, et al., 2024); (Umar et al., 2024b);(Thathsarani & Jianguo, 2022).

3.6 Discussion

a. The Influence of the Digital Economy on Financial Inclusion

The findings of this study confirm that the digital economy plays a significant role in enhancing financial inclusion among MSMEs. This relationship is reflected in the direct and positive influence of digital economic indicators—such as business model innovation, awareness of digital financial services, value propositions tailored to customers, and supporting digital infrastructure—on the financial behaviors of MSME actors. These results are consistent with previous research showing that digital financial ecosystems enable broader access to financial products and services for previously underserved or excluded business actors (Kumar Chaudhary, Mani Ghimire, et al., 2024; Paliwal, 2024).

In the context of Indonesian MSMEs, the digital economy enables broader participation in the formal financial sector by reducing barriers related to geography, time, and operational complexity (Ozili, 2018). The widespread use of mobile payment systems, digital marketplaces, and online banking platforms facilitates daily financial transactions, improves credit access, and enhances business formalization. These results highlight the importance of digital economy policies that are inclusive and responsive to the needs of small business actors. They also affirm that the digital economy does not merely represent technological progress, but a structural opportunity to improve the financial resilience of the MSME sector. The digital economy strongly enhances technology adoption, yet its direct effect on financial inclusion is limited due to infrastructural gaps and behavioral barriers such as trust and perceived risk. These constraints weaken the conversion of digital readiness into actual financial usage. Thus, adoption behavior functions as a necessary mediating mechanism.

b. The Influence of the Digital Economy on Technology Adoption

This study also finds a strong and statistically significant relationship between digital economic development and technology adoption among MSMEs. The digital economy, as a macro-environmental enabler, creates conditions that influence business owners' attitudes and intentions to use technology. The findings align with prior research that emphasizes the contextual role of digitalization in shaping the perceptions of ease of use, usefulness, and credibility of technological tools among entrepreneurs (Thathsarani & Jianguo, 2022)

Technological adoption is not only determined by the intrinsic features of the technology but also by the surrounding digital infrastructure and digital literacy level. In this context, the awareness and availability of digital financial services in Sukabumi

foster a more favorable environment for MSME actors to embrace and utilize digital tools. The presence of user-friendly applications, online customer support, and simplified registration processes increases user confidence and supports the development of digital competencies (Bansal, 2014). These findings reinforce the argument that digital economic development must be accompanied by continuous support in the form of training, incentives, and platform accessibility for small business players. Technology adoption in Sukabumi is shaped by unequal digital literacy, inconsistent internet infrastructure, and traditional cash-based business practices. These local conditions affect user readiness and trust toward digital systems. As a result, adoption outcomes vary significantly across MSME segments.

c. The Influence of Technology Adoption on Financial Inclusion

The study further demonstrates that technology adoption—measured through TAM constructs—has a significant and direct impact on financial inclusion. This result supports the TAM premise that perceived usefulness, ease of use, credibility, and self-efficacy positively influence individuals' attitudes toward using digital financial services. MSMEs that view digital platforms as trustworthy and easy to use are more likely to adopt them, which in turn enhances their access to and usage of formal financial systems. This finding is supported by studies such as those of Dimoso and Utonga (2024), who note that digital financial services are more readily adopted when users perceive them to be effective and secure (Lucian Dimoso & Utonga, 2024), and Vyas and Jain (2021), who argue that trust and perceived benefits are crucial in digital engagement decisions (Vyas & Jain, 2021b).

Importantly, the influence of technology adoption also implies the existence of an attitudinal bridge between the availability of digital financial services and their actual utilization. This insight is critical for policymakers and digital service providers, as it underlines the importance of designing technology not only to be functional but also psychologically acceptable and accessible to end users.

d. The Mediating Role of Technology Adoption

One of the major contributions of this study is the confirmation of the mediating role of technology adoption in the relationship between the digital economy and financial inclusion. The findings reveal that digital economic variables influence financial inclusion both directly and indirectly through MSME actors' acceptance and use of digital technology. This mediating role highlights that without positive perceptions and behaviors toward digital tools, the potential of the digital economy to support inclusive finance may not be fully realized. This aligns with the theoretical framework of TAM, which positions behavioral intention as a necessary step in technology-enabled change.

This finding offers a critical extension to previous literature, which often separates structural enablers (such as infrastructure) from individual behavioral responses. By placing technology adoption at the center of the digital inclusion process, this study offers a more comprehensive model that integrates macro and micro-level drivers of financial access. Studies such as those by Daud and Ahmad (2022) and Umar et al. (2024) support the notion that financial inclusion outcomes depend on the convergence of technological availability and behavioral readiness (Daud & Ahmad, 2023; Umar et al., 2024a).

e. Contributions, Limitations, and Implications

This article contributes to the body of knowledge by integrating the digital economy and technology adoption variables into a unified framework to explain financial inclusion. Unlike earlier studies that treat these variables separately, this model demonstrates the interconnectedness of structural and behavioral dimensions in digital transformation. The study also provides empirical validation of TAM in the specific

context of Indonesian MSMEs, thus extending the model's applicability to emerging market contexts with varying levels of digital readiness.

However, the research has several limitations that should be acknowledged. The study's focus on a single geographic region (Sukabumi City) may limit the generalizability of its findings. Additionally, the cross-sectional nature of the data does not allow for analysis of behavioral changes over time. Future research could adopt longitudinal methods or expand the study to different regions and sectors to validate and refine the model further.

From a practical standpoint, the study offers important implications for policy and practice. Policymakers should prioritize digital literacy programs, improve access to digital infrastructure, and ensure that digital financial services are designed with user experience in mind. For practitioners and financial service providers, the study emphasizes the need to foster trust, ease of access, and clear value propositions to support broader adoption among MSMEs. These actions are vital to transforming digital economy potential into tangible and inclusive financial outcomes.

4. CONCLUSION

This study confirms that the digital economy has a significant and positive impact on financial inclusion among MSMEs, both directly and through the mediating effect of technology adoption. The development of digital infrastructure, business models, and financial platforms has created new opportunities for MSMEs to access and utilize formal financial services more effectively. At the same time, the level of technology acceptance—reflected in users' perceptions of ease of use, usefulness, credibility, and self-efficacy—plays a crucial role in determining the extent to which these digital services are adopted and integrated into daily business operations. The empirical findings demonstrate that technology adoption not only supports financial access but also bridges the gap between digital economic growth and inclusive finance.

Theoretically, this research contributes to the development of an integrative framework that connects the Technology Acceptance Model (TAM) with the digital economy to explain financial inclusion behavior. It expands the application of TAM beyond its traditional scope by validating its relevance in the MSME sector within a developing country context. Practically, the study provides valuable insights for policymakers and financial technology developers to design interventions that strengthen digital literacy, build trust in digital platforms, and enhance infrastructure that supports MSME participation in the digital economy.

Moving forward, future research may explore broader geographical coverage and employ longitudinal methods to capture the dynamic changes in digital engagement and financial behavior over time. Additionally, interdisciplinary approaches that combine behavioral, technological, and economic perspectives are recommended to further enrich the understanding of financial inclusion in the digital era.

Future research should incorporate digital literacy, infrastructure access, and fintech service quality to capture broader determinants of digital engagement. These variables can moderate or enhance the pathways identified in this model. Their inclusion would strengthen theoretical completeness and practical relevance.

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