Blockchain Frontier Technology (BFRONT)
Vol. 6, No. 2, January, 2027, pp. 216∼228
E-ISSN: 2808-0009 | P-ISSN: 2808-0831, DOI: 10.34306

Digital Banking Adoption and MSMEs Resilience in Blockchain Enabled Financial Ecosystems

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Article Info

Article history:

Submission, 08-07-2026
Revised, 26-08-2026
Accepted, 29-09-2026
Published, 30-09-2026

Keywords:

Digital Banking Adoption
Financial Resilience
Financial Literacy
Blockchain-Enabled
Financial Ecosystem

ABSTRACT

The growing adoption of digital financial technologies has provided Micro, Small, and Medium Enterprises (MSMEs) with opportunities to improve financial management and resilience within emerging blockchain-enabled financial ecosystems. However, digital banking adoption does not necessarily ensure that technological access will result in stronger financial resilience. Previous studies have commonly examined digital banking adoption, financial literacy, and financial resilience independently, leaving limited understanding of how these factors interact through financial management practices and financial capabilities. This **study investigates** the influence of Digital Banking Adoption on MSMEs' Financial Resilience, with Financial Planning serving as a mediating mechanism and Financial Literacy as a moderating factor. The novelty of this study lies in developing an integrated behavioral and financial capability framework that connects digital banking adoption with MSMEs' financial resilience while considering blockchain-enabled financial ecosystems as the broader technological context. A **quantitative cross-sectional** design was employed using data from 300 MSMEs owners or managers in Indonesia who actively use digital banking services. The data were analyzed using PLS-SEM. The results show that Digital Banking Adoption significantly affects Financial Planning ($\beta = 0.72$, $p < 0.001$) and Financial Resilience ($\beta = 0.24$, $p = 0.003$). Financial Planning significantly affects Financial Resilience ($\beta = 0.48$, $p < 0.001$) and mediates the relationship ($\beta = 0.35$, $p < 0.001$). Financial Literacy negatively moderates the relationship ($\beta = -0.18$, $p = 0.015$), suggesting that higher financial literacy may reduce digital banking's marginal contribution to resilience.

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DOI: https://doi.org/10.34306/b-front.v6i2.1203
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1. INTRODUCTION

The rapid advancement of digital technologies has transformed the financial sector by expanding access to digital banking services and reshaping how businesses conduct, monitor, and manage financial activities. Beyond conventional digital banking, the evolution of blockchain and DLT has introduced new possibilities for financial ecosystems by strengthening transaction transparency, data integrity, traceability, trust, and secure information exchange [1, 2, 3]. Blockchain-enabled financial systems therefore represent an emerging frontier in digital finance, particularly as financial institutions and businesses increasingly explore technology

infrastructures that can support more secure, transparent, and resilient financial services [4, 5]. Within this transformation, digital banking adoption remains an important entry point through which enterprises interact with increasingly technology-driven financial ecosystems [6, 7, 8].

MSMEs are particularly relevant to this transformation because of their important contribution to economic activity and employment, while their limited financial resources and restricted access to formal financial services can increase their vulnerability to economic disruptions [9, 10, 11]. In emerging economies such as Indonesia, strengthening MSMEs financial resilience is therefore essential for maintaining business continuity and supporting sustainable economic development. The expansion of digital financial services provides MSMEs with greater access to financial information, transaction facilities, and financial management tools. At the same time, emerging blockchain-enabled financial infrastructures may further support trustworthy and transparent digital financial ecosystems by improving the integrity and traceability of financial information [12, 13, 14]. However, technological availability alone does not necessarily ensure that MSMEs can translate digital financial access into stronger financial resilience [15, 16].

The effectiveness of digital financial technologies depends on how businesses adopt and utilize the available services [17, 18, 19]. Digital banking can provide real-time transaction information, facilitate financial transactions, and support financial monitoring, while blockchain-enabled financial ecosystems can potentially strengthen trust, transparency, and data integrity within digital transactions. These technological capabilities may help MSMEs improve their financial management. However, the benefits of digital financial technologies ultimately depend on users' ability to incorporate them into appropriate financial practices. Financial planning is particularly important because it enables MSMEs to translate financial information and digital transaction capabilities into budgeting, cash-flow management, resource allocation, and risk-management decisions. Financial literacy may also determine the extent to which MSMEs understand and effectively utilize increasingly complex digital financial services [20].

Previous studies have extensively examined digital banking adoption in relation to technology acceptance, financial behavior, and financial performance, while research on financial resilience has frequently focused on households and individual consumers. Comparatively less attention has been given to MSMEs and to the mechanisms through which digital banking adoption can contribute to business-level financial resilience. In particular, the interaction between technology adoption, financial planning, and financial literacy remains insufficiently integrated into a single empirical framework. Furthermore, although blockchain and DLT are increasingly recognized as important components of emerging financial ecosystems, limited empirical attention has been given to how the broader transition toward blockchain-enabled and digitally integrated financial environments can be connected with MSMEs' financial management and resilience. This creates an opportunity to examine digital banking adoption within the wider technological transformation of blockchain-enabled financial ecosystems rather than treating digital banking solely as a conventional financial service.

The present study addresses this gap by examining the relationship between digital banking adoption and MSMEs' financial resilience, with financial planning positioned as a mediating mechanism and financial literacy as a moderating condition. The study extends the TAM and financial capability perspective by proposing that the value of digital financial technology is not determined only by adoption, but also by the financial practices and capabilities through which technological access is converted into resilience [21, 22, 23]. This perspective is relevant to the Blockchain Frontier Technology domain because blockchain-enabled financial ecosystems require not only technological infrastructures that provide transparency, trust, and data integrity but also effective organizational and financial utilization of these technologies. Accordingly, the study contributes to the blockchain applications and sectoral innovation perspective by examining how technology-enabled financial transformation can support MSMEs sustainability and resilience. The study addresses three research questions.

- (RQ1) How does digital banking adoption influence financial planning and financial resilience among MSMEs?
- (RQ2) What role does financial planning mediate the relationship between digital banking adoption and MSMEs financial resilience?
- (RQ3) Does financial literacy enhance the relationship between digital banking adoption and financial resilience?

By addressing these research questions, this study aims to develop a comprehensive perspective on the behavioral factors and user capabilities that shape financial resilience within technology-driven financial ecosystems. The results are expected to offer practical insights for financial institutions and technology providers by emphasizing that technological advancement should be accompanied by the development of users' financial capabilities. In addition, the findings can inform policymakers in designing policies and initiatives that promote more inclusive, adaptive, and resilient digital financial ecosystems. More broadly, this research contributes to the Sustainable Development Goals (SDGs), particularly SDGs 8, which promotes decent work and economic growth, and SDGs 9, which focuses on industry, innovation, and infrastructure, by demonstrating the potential role of digital financial technologies in supporting sustainable and resilient activities among Micro, Small, and Medium-Sized Enterprises (MSMEs).

2. LITERATURE REVIEW

2.1. Digital Banking Adoption

Digital banking adoption represents the degree to which individuals or businesses integrate digital banking services into their financial activities, including conducting transactions, retrieving financial information, and managing banking-related operations [9, 24, 25]. According to the Technology Acceptance Model (TAM), users' willingness to adopt a technology is largely determined by their perceptions of its usefulness and ease of use. For MSMEs, the implementation of digital banking services can expand access to financial facilities, simplify the tracking of business transactions, and enable more timely access to financial information [12, 26]. These capabilities can support MSMEs owners in monitoring their financial conditions and making more informed business decisions. Recent studies indicate that digital transformation has increasingly influenced MSMEs' financial activities by improving access to digital financial services and supporting more efficient financial management [27, 28, 29]. Thus, digital banking adoption provides MSMEs with technological resources that can support more systematic management of financial resources.

The technological environment surrounding digital banking is also evolving through blockchain and Distributed Ledger Technology (DLT). Blockchain provides distributed and tamper-resistant transaction records, while transparency, immutability, and decentralized verification can support new models of financial transactions and data management [30, 31, 32]. Recent research has identified blockchain applications in banking and financial services, including transaction processing, payment systems, financial inclusion, and digital financial activities [33, 34, 35]. Blockchain-enabled financial ecosystems can also incorporate smart contracts to automate predefined financial processes and transactions, potentially improving efficiency, transparency, and trust among participating entities [**?**, 4, 36]. However, challenges related to scalability, interoperability, security, privacy, and regulatory uncertainty remain important considerations [37]. In this study, blockchain is positioned as an emerging technological context rather than an additional empirical construct. The availability of digital financial information and transaction records is expected to facilitate budgeting, monitoring, and resource allocation, leading to the following hypothesis:

- H1: Digital banking adoption contributes positively to individuals' financial planning.

2.2. Financial Planning

Financial planning refers to the systematic process of managing financial resources through budgeting, cash-flow management, saving, investment decisions, and risk management to achieve financial objectives [38]. For MSMEs, effective financial planning is particularly important because limited financial resources and exposure to economic uncertainty require businesses to anticipate financial needs, allocate resources efficiently, and maintain adequate liquidity [39, 40]. Digital banking can support this process by providing transaction histories, account information, payment records, and timely financial information [41]. However, digital access alone does not guarantee effective financial planning because MSMEs must be able to interpret financial information and transform it into appropriate managerial decisions [42].

Financial planning can also strengthen financial resilience by enabling MSMEs to anticipate financial risks, manage cash flows, maintain liquidity, and prepare for unexpected expenditures. Previous research has identified financial planning as an important factor associated with MSMEs performance and financial resilience [43]. This suggests that financial planning represents an important financial capability through which

digital financial information can be converted into structured financial management practices and adaptive responses to financial shocks. Therefore, MSMEs with more effective financial planning are expected to demonstrate stronger financial resilience.

- H2: Financial planning is positively associated with financial resilience.

2.3. Financial Literacy

Financial literacy refers to the knowledge and understanding of financial concepts and the ability to apply such knowledge in making appropriate financial decisions. Financial literacy is particularly important for MSMEs because business owners and managers must evaluate financial products, understand financial risks, manage cash flows, and make informed decisions regarding financial resources [44]. In an increasingly digital financial environment, financial literacy also influences the ability of MSMEs to understand and utilize digital financial services effectively. Recent research indicates that financial literacy and digital capabilities are important factors in supporting financial management and financial resilience among MSMEs [45].

In this study, financial literacy is conceptualized as a moderating variable because the benefits of digital banking may differ according to the financial capabilities of MSMEs. MSMEs with higher financial literacy are expected to better interpret digital transaction information, evaluate financial alternatives, manage risks, and use digital banking services for strategic financial decisions. Conversely, MSMEs with lower financial literacy may have access to similar digital banking services but may be less capable of converting digital financial access into improved financial outcomes [46]. Financial literacy therefore represents a boundary condition that may influence the strength of the relationship between digital banking adoption and financial resilience.

2.4. Financial Resilience

Financial resilience refers to the ability of businesses to withstand, adapt to, and recover from financial shocks while maintaining essential business operations [47, 48]. For MSMEs, financial resilience is particularly important because smaller businesses commonly have limited financial buffers, restricted access to external financing, and greater sensitivity to economic disruptions. Financial resilience therefore extends beyond financial performance because it reflects the capacity of MSMEs to maintain financial stability and adapt when confronted with unexpected financial challenges. Recent research has increasingly linked MSMEs financial resilience with financial literacy, financial decisions, financial inclusion, and digital financial capabilities [49, 50].

Digital banking can contribute to financial resilience by improving access to financial services, facilitating transactions, providing timely financial information, and supporting more efficient financial management. Digital financial information can improve financial visibility and allow MSMEs to respond more quickly to changes in their financial conditions [51]. Furthermore, blockchain-enabled financial infrastructure may strengthen the broader financial ecosystem through transparent and verifiable transaction records, data integrity, and automated financial processes. Nevertheless, technological access alone may not guarantee financial resilience because its effectiveness depends on how MSMEs utilize available financial resources and information. Accordingly, digital banking adoption is expected to have a direct positive relationship with financial resilience.

- H3: Digital banking adoption contributes to the improvement of financial resilience.

2.4.1. Mediating Role of Financial Planning

The mediating role of financial planning is based on the argument that digital banking provides technological resources, while financial planning represents the managerial mechanism through which these resources are transformed into financial actions. Digital banking increases the accessibility and timeliness of financial information, enabling MSMEs to monitor transactions, assess financial conditions, and identify financial requirements. However, financial information alone does not create financial resilience unless it is incorporated into systematic planning and decision-making. Financial planning therefore enables MSMEs to convert digital financial information into budgeting, cash-flow management, resource allocation, and risk-preparation activities.

This mechanism suggests that digital banking adoption can first improve the information resources available to MSMEs, which subsequently facilitates financial planning and ultimately strengthens financial resilience. Previous research has identified financial planning as an important capability associated with MSMEs

financial outcomes. Thus, financial planning provides a theoretical explanation of how digital banking adoption may contribute to financial resilience rather than assuming that technological adoption automatically produces resilience. Based on this mechanism, the following hypothesis is proposed:

- H4: Financial planning acts as an intermediary between digital banking adoption and financial resilience.

2.4.2. Moderating Role of Financial Literacy

The moderating relationship is based on the premise that the effect of digital banking adoption on financial resilience may vary according to the financial literacy of MSMEs. Digital banking provides access to financial information and digital financial tools, but MSMEs require sufficient financial knowledge to interpret such information and make appropriate decisions. MSMEs with higher financial literacy are expected to understand digital financial information more effectively, evaluate financial risks, and use digital banking features for financial management. Consequently, financial literacy may strengthen the ability of MSMEs to translate digital banking adoption into improved financial resilience.

Conversely, MSMEs with lower financial literacy may have access to the same digital banking services but may experience greater difficulty interpreting financial information, evaluating financial alternatives, or managing digital financial products. Previous studies have demonstrated the relevance of financial literacy to financial resilience and financial decision-making among MSMEs. Therefore, financial literacy is expected to function as a boundary condition of the relationship between digital banking adoption and financial resilience, with the relationship expected to be stronger among MSMEs with higher financial literacy.

- H5: Financial literacy positively moderates the relationship between digital banking adoption and financial resilience.

2.5. Comparative Analysis of Previous Studies and Research Gap

To clarify the theoretical foundation and identify the research gap, previous studies are compared based on their research context, main focus, findings, and limitations. Existing blockchain studies generally examine technological applications in financial services, including transaction efficiency, transparency, security, automation, and financial inclusion. Meanwhile, studies focusing on SMEs and MSMEs have primarily examined financial planning, financial literacy, digital capabilities, and financial resilience. These research streams have generally developed separately, resulting in limited understanding of how digital banking adoption can be connected with financial management capabilities and business resilience within an emerging blockchain-enabled financial ecosystem.

Table 1. Comparison of Previous Studies and Research Position

References	Context	Main Focus	Main Finding	Research Limitation
[27]	Financial services	Blockchain and finance	Blockchain supports distributed financial transactions	Does not examine MSMEs financial resilience
[5]	Financial sector	Blockchain applications	Blockchain supports transparency and financial efficiency	Focuses on technological aspects rather than financial capability
[52]	Banking	Blockchain-enabled banking	Blockchain supports digital banking processes	Does not examine financial planning or financial resilience
[14]	Digital finance	Blockchain and financial inclusion	Blockchain can support financial inclusion	Does not specifically examine MSMEs financial resilience
[53]	Financial ecosystem	Smart contracts	Smart contracts support automated financial transactions	Focuses primarily on technological mechanisms
[36]	SMEs	Financial planning and financial outcomes	Financial planning supports SMEs financial management and outcomes	Does not integrate digital banking adoption
[54]	MSMEs	Financial literacy, digital capabilities, and financial resilience	Financial capabilities contribute to MSMEs' financial resilience	Does not integrate digital banking adoption, financial planning as a mediator, and financial literacy as a moderator

Table 1 summarizes prior studies and highlights a research gap in integrating digital banking adoption, financial planning, and financial literacy to explain MSMEs financial resilience, providing the basis for the integrated model.

3. RESEARCH METHODOLOGY

3.1. Research Design

This study employs a quantitative cross-sectional design to examine the relationships among digital banking adoption, financial planning, financial literacy, and financial resilience among MSMEs in Indonesia. Financial planning is positioned as a mediator, while financial literacy serves as a moderator. PLS-SEM using SmartPLS is applied because the model includes multiple latent constructs and direct, mediation, and moderation relationships.

3.2. Population, Sampling, and Sample Size

Purposive sampling is applied based on specific eligibility criteria, including respondents who own or manage an MSMEs, businesses that have been operating for a minimum period, and businesses that utilize digital banking for business-related activities. The study involves a sample of MSMEs owners or managers who meet these criteria.

3.3. Data Collection and Ethical Considerations

The study employed structured questionnaires administered through online and offline channels to obtain the required data. The instrument comprised two main components: questions concerning respondent and business characteristics and measurement items for digital banking adoption, financial planning, financial literacy, and financial resilience. Each item was evaluated using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Respondents participated voluntarily and were informed about the confidentiality of the information provided and the academic objectives of the study. Where applicable, ethical approval was obtained and informed consent was provided by the participants.

3.4. Measurement of Variables

The study measures four constructs: digital banking adoption as the independent variable, financial planning as the mediator, financial literacy as the moderator, and financial resilience as the dependent variable. Measurement items are adapted from previous studies and aligned with the conceptual definitions of each construct.

Table 2. Measurement of Variables

Variable	Code	Indicator	Description
Digital Banking Adoption	DBA1	Ease of Use	Digital banking is easy to use
	DBA2	Usefulness	Digital banking improves business transactions
	DBA3	Frequency	Digital banking is frequently used for financial activities
Financial Planning	FP1	Budgeting	Regular financial budgeting
	FP2	Cash Flow	Monitoring financial inflows and outflows
	FP3	Financial Goals	Setting financial targets
Financial Literacy	FL1	Knowledge	Understanding financial concepts
	FL2	Risk	Ability to manage financial risks
	FL3	Decision	Ability to make financial decisions
Financial Resilience	FR1	Stability	Ability to maintain financial stability
	FR2	Shock Resistance	Ability to withstand financial shocks
	FR3	Recovery	Ability to recover after financial losses

Table 2 presents the measurement of the four constructs used in this study: Digital Banking Adoption, Financial Planning, Financial Literacy, and Financial Resilience. Each construct is operationalized through three indicators that capture key dimensions of the respective variables. Digital Banking Adoption is measured through ease of use, usefulness, and frequency of use, while Financial Planning covers budgeting, cash flow monitoring, and financial goals. Financial Literacy is assessed through financial knowledge, risk management, and decision-making ability, whereas Financial Resilience is measured through financial stability, shock resistance, and recovery ability. These indicators provide the basis for assessing the proposed relationships among the constructs using PLS-SEM.

3.5. PLS-SEM Analysis

The collected data are analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS. The analysis follows two consecutive stages, beginning with the evaluation of the measurement model and proceeding to the assessment of the structural model. PLS-SEM is employed because the research model involves several latent constructs and requires the simultaneous assessment of direct effects as well as mediation and moderation relationships from a predictive.

The measurement model is examined by evaluating indicator reliability, internal consistency, convergent validity, and discriminant validity. Indicator reliability is determined from the outer loading coefficients, with values above 0.70 indicating satisfactory reliability. Internal consistency is subsequently assessed using Cronbach's Alpha and Composite Reliability (CR), for which coefficients exceeding 0.70 are considered to demonstrate acceptable reliability.

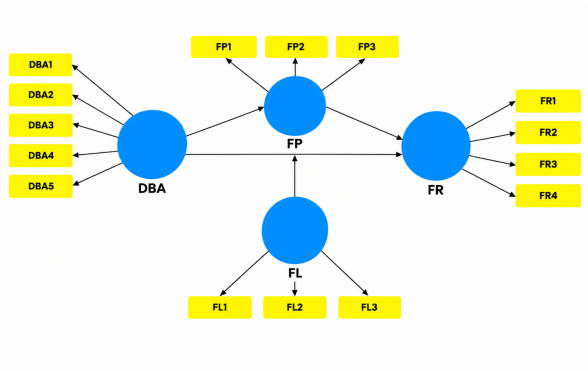


Figure 1. PLS-SEM Analysis

Figure 1 illustrates the research workflow, from research problem identification and theoretical development to data collection and analysis. The process includes measurement and structural model assessment SMEs, followed by testing of direct, mediation, and moderation effects. The final stage focuses on interpreting the findings and their implications.

3.6. Research Workflow

The research methodology followed a structured sequence consisting of problem identification, literature review, development of the theoretical framework and hypotheses, questionnaire preparation, data collection and screening, assesSMEsnt of common method bias, evaluation of the measurement and structural models, hypothesis testing, mediation and moderation analyses, and interpretation of the findings.

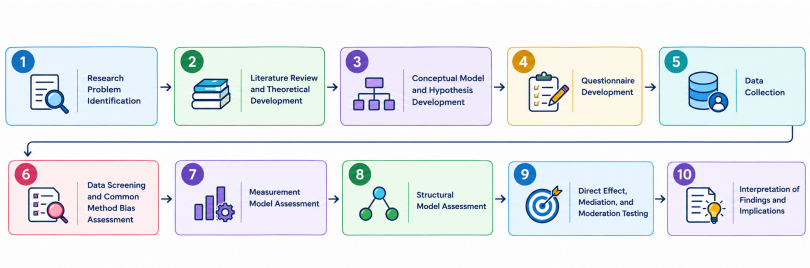


Figure 2. Research Workflow

The conceptual model illustrates Figure 2 proposed relationships among digital banking adoption, financial planning, financial literacy, and financial resilience. Digital banking adoption is positioned as the independent variable, while financial planning serves as the mediator and financial literacy serves as the moderator. Financial resilience represents the dependent variable. The model also incorporates the broader context of emerging blockchain-enabled financial ecosystems discussed in the Introduction and Literature Review. Importantly, blockchain and DLT are not included as additional empirical constructs in the statistical model. Instead, they are positioned as an emerging technological context surrounding the development of digital financial services.

4. RESULTS AND DISCUSSION

4.1. Respondent Profile

A total of 300 respondents were included in the study. The respondents consisted of MSMEs owners or managers who met the predetermined sampling criteria and had experience using digital banking services. The respondent characteristics were examined based on demographic and business-related information to ensure that the sample was relevant to the research context.

Table 3. Respondent Characteristics

Characteristics	Category	Frequency	Percentage
Gender	Male	80	40%
	Female	120	60%
Business Age	$<$ 3 years	80	40%
	$\geq$ 3 years	120	60%
Digital Banking Usage	Active users	200	100%

Table 3 indicates that the majority of respondents are female (60%), while 40% are male. In terms of business age, 60% of the respondents have operated their businesses for three years or more, while 40% have operated for less than three years. All respondents are active users of digital banking services, confirming their relevance to the study examining the relationship between digital banking adoption and MSMEs financial resilience.

4.2. Measurement Evaluation

The adequacy of the measurement model was evaluated through assessments of indicator reliability, internal consistency reliability, and convergent validity.

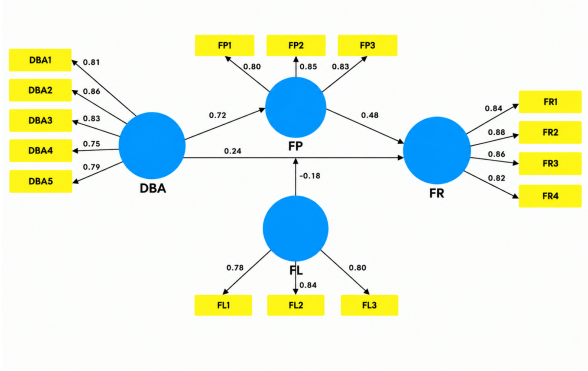


Figure 3. Structural Model Results

Figure 3 indicates that the measurement indicators exhibit satisfactory loading values across all constructs. Digital Banking Adoption has loadings ranging from 0.75 to 0.86, followed by Financial Planning with values between 0.80 and 0.85. The loading coefficients for Financial Literacy range from 0.78 to 0.84, while Financial Resilience presents the highest range, from 0.82 to 0.88. As each value surpasses the 0.70 benchmark, the indicators can be considered sufficiently reliable for measuring their respective constructs.

Table 4. Measurement Model

Variable	Loading Range	AVE	CR
Digital Banking Adoption	0.75–0.86	0.62	0.87
Financial Planning	0.80–0.85	0.65	0.89
Financial Literacy	0.78–0.84	0.60	0.86
Financial Resilience	0.82–0.88	0.68	0.90

The results in Table 4 demonstrate that the measurement model satisfies the required criteria for reliability and convergent validity, providing a sound basis for subsequent structural model analysis.

4.3. Hypothesis Testing

The mediation relationship proposed in H4 is also supported, indicating that Financial Planning provides an indirect mechanism linking Digital Banking Adoption to Financial Resilience. Finally, the interaction between Digital Banking Adoption and Financial Literacy is significant and negative ($\beta = -0.18$, $p = 0.015$), supporting H5. The negative coefficient indicates that Financial Literacy negatively moderates the relationship between Digital Banking Adoption and Financial Resilience.

Table 5. Hypothesis Testing Results

Relationship	β	T-Statistic	P-Value	Decision
DBA $\rightarrow$ FP	0.72	6.12	< 0.001	Supported
FP $\rightarrow$ FR	0.48	5.45	< 0.001	Supported
DBA $\rightarrow$ FR	0.24	2.98	0.003	Supported
DBA $\rightarrow$ FP $\rightarrow$ FR	0.35	4.10	< 0.001	Supported
DBA $\times$ FL $\rightarrow$ FR	-0.18	2.45	0.015	Supported

Table 5 presents the results of hypothesis testing. The findings show that Digital Banking Adoption has a strong positive effect on Financial Planning ($\beta = 0.72$, $p < 0.001$), supporting H1. Financial Planning also has a significant positive effect on Financial Resilience ($\beta = 0.48$, $p < 0.001$), supporting H2. In addition, Digital Banking Adoption has a positive direct effect on Financial Resilience ($\beta = 0.24$, $p = 0.003$), supporting H3. The findings show that Digital Banking Adoption positively affects Financial Planning ($\beta = 0.72$, $p < 0.001$) and Financial Resilience ($\beta = 0.24$, $p = 0.003$). Financial Planning also positively affects Financial Resilience ($\beta = 0.48$, $p < 0.001$) and mediates the relationship between Digital Banking Adoption and Financial Resilience. However, Financial Literacy negatively moderates this relationship ($\beta = -0.18$, $p = 0.015$), suggesting that financially literate MSMEs may rely less on digital banking as a resilience mechanism. Overall, the findings indicate that digital banking, financial planning, and financial literacy jointly contribute to MSME financial resilience and highlight the importance of integrating financial management features into digital banking services.

5. MANAGERIAL IMPLICATIONS

The strong positive relationship between Digital Banking Adoption and Financial Planning ($\beta = 0.72$) suggests that managers can maximize the value of digital banking by actively using transaction histories, account information, payment records, budgeting tools, and cash-flow monitoring features to support financial decision-making. MSMEs managers should therefore integrate digital banking information into routine financial planning, including cash-flow forecasting, budgeting, liquidity management, and preparation for unexpected financial needs. Financial institutions can support this process by designing digital banking platforms with integrated financial management features that are simple, accessible, and relevant to MSME operational needs.

The findings also suggest that managerial strategies should consider differences in financial literacy when implementing digital financial technologies. Although digital banking directly contributes to financial resilience, the significant interaction between Digital Banking Adoption and Financial Literacy ($\beta = -0.18$, $p = 0.015$) indicates that the marginal contribution of digital banking may differ across MSMEs with different levels of financial capability. Managers should therefore strengthen financial knowledge and decision-making capabilities alongside digital technology adoption rather than assuming that access to digital banking automatically produces stronger resilience. For financial institutions, this implies that digital banking services for MSMEs should be complemented by financial education, financial planning guidance, and tools that help users interpret financial information.

6. CONCLUSION

This study investigates the contribution of Digital Banking Adoption to the financial resilience of MSMEs by examining Financial Planning as a mediating mechanism and Financial Literacy as a moderating factor. The findings demonstrate that Digital Banking Adoption has a significant positive effect on both Financial Planning and Financial Resilience. Financial Planning also shows a significant and positive association with Financial Resilience. The mediation analysis indicates that Financial Planning serves as an important

pathway through which the benefits of digital banking can be converted into stronger financial resilience. In contrast, the interaction between Digital Banking Adoption and Financial Literacy produces a significant negative effect, indicating that the contribution of digital banking to financial resilience tends to diminish at higher levels of financial literacy. This finding may be explained by the possibility that MSMEs with greater financial literacy already possess more established financial management capabilities, thereby reducing their dependence on digital banking as an additional mechanism for strengthening financial resilience.

From a theoretical perspective, the findings extend the Technology Acceptance Model and the financial capability perspective by demonstrating that digital technology adoption alone cannot fully explain differences in MSMEs' financial resilience. The benefits obtained from digital banking appear to be shaped by complementary financial practices, particularly Financial Planning, together with the financial capabilities of MSME owners and managers. The study also contributes to the discussion of blockchain-enabled financial ecosystems by placing digital banking within a broader technological environment characterized by secure, transparent, and increasingly programmable financial infrastructures. Although blockchain technology is not operationalized as an empirical construct in this research, its key characteristics provide an appropriate contextual foundation for understanding the ongoing transformation of digital financial services and their potential contribution to more efficient and resilient financial ecosystems. From a practical perspective, financial institutions should consider embedding budgeting features, cash-flow monitoring, financial planning functions, and other financial management tools into digital banking platforms. Policymakers should also complement digital financial inclusion initiatives with targeted programs aimed at improving financial capabilities. At the organizational level, MSMEs should strengthen their financial planning practices to ensure that digital financial access can be effectively transformed into strategies that support financial resilience.

Several limitations need to be considered when interpreting the findings. The cross-sectional design limits the extent to which the identified relationships can be interpreted as causal or observed over an extended period. The study is also limited to Indonesian MSMEs, which may constrain the applicability of the findings to businesses operating in other countries, industries, or institutional settings. In addition, the use of self-reported questionnaire data may introduce response-related and self-reporting biases. Future research could address these limitations by adopting longitudinal or experimental research designs to investigate changes in MSMEs' financial resilience over time. Subsequent studies could also incorporate additional technological, organizational, and behavioral factors to develop a more comprehensive understanding of how digital financial technologies influence MSME resilience. Furthermore, blockchain-related financial applications, including smart contracts, decentralized financial services, and DLT, could be examined as empirical constructs in future research. Such investigations would provide stronger empirical insights into how emerging blockchain-based infrastructures can contribute to the development of sustainable, adaptive, and resilient financial ecosystems for MSMEs.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: IR; Methodology: AH; Software: RE; Validation: IR; Formal Analysis: AH and RE; Investigation: IR; Resources: RE; Data Curation: AH; Writing – Original Draft: IR; Writing – Review and Editing: RE; Visualization: AH. All authors, including IR, AH and RE, reviewed and approved the final version of the manuscript for publication.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

7.4. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

REFERENCES

[1] Y. Xia, Z. Qiao, and G. Xie, "Corporate resilience to the covid-19 pandemic: The role of digital finance," *Pacific-Basin Finance Journal*, vol. 74, p. 101791, 2022.

[2] D. Tribuana, U. Narimawati, and M. Y. Syafei, "A multi-group structural analysis of digital banking adoption determinants across generational cohorts in indonesia," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 8, no. 1, pp. 37–50, 2026.

[3] R. Graña-Alvarez, E. Lopez-Valeiras, M. Gonzalez-Loureiro, and F. Coronado, "Financial literacy in smes: A systematic literature review and a framework for further inquiry," *Journal of Small Business Management*, vol. 62, no. 1, pp. 331–380, 2024.

[4] D. Aassouli and H. Ahmed, "Supporting smes financial resilience during crises: A framework to evaluate the effectiveness of financial literacy programs targeting smes," *Malaysian Journal of Economic Studies*, vol. 60, no. 1, pp. 105–121, 2023.

[5] K. John, L. Kogan, and F. Saleh, "Smart contracts and decentralized finance," *Annual Review of Financial Economics*, vol. 15, no. 1, pp. 523–542, 2023.

[6] A. Hassan, I. Makhdoom, W. Iqbal, A. Ahmad, and A. Raza, "From trust to truth: Advancements in mitigating the blockchain oracle problem," *Journal of Network and Computer Applications*, vol. 217, p. 103672, 2023.

[7] A. Ruangkanjanases, A. Khan, O. Sivarak, U. Rahardja, and S.-C. Chen, "Modeling the consumers' flow experience in e-commerce: The integration of ecm and tam with the antecedents of flow experience," *SAGE Open*, vol. 14, no. 2, p. 21582440241258595, 2024.

[8] M. Shah, R. Seranmadevi, S. Jose, and A. Tyagi, "Blockchain for banking and finance: A survey," *Convergence of technology and operations management in modern businesses*, 2024.

[9] S. M. M. Rahman, K.-J. Yii, E. K. Masli, and M. L. Voon, "The blockchain in the banking industry: a systematic review and bibliometric analysis," *Cogent Business & Management*, vol. 11, no. 1, p. 2407681, 2024.

[10] T. Hidayat, D. Manongga, Y. Nataliani, S. Wijono, S. Y. Prasetyo, E. Maria, U. Raharja, I. Sembiring *et al.*, "Performance prediction using cross validation (gridsearchcv) for stunting prevalence," in *2024 IEEE International Conference on Artificial Intelligence and Mechatronics Systems (AIMS)*. IEEE, 2024, pp. 1–6.

[11] H. Wu, Q. Yao, Z. Liu, B. Huang, Y. Zhuang, H. Tang, and E. Liu, "Blockchain for finance: A survey," *IET blockchain*, vol. 4, no. 2, pp. 101–123, 2024.

[12] H. Chen, N. Wei, L. Wang, W. F. M. Mobarak, M. A. Albahar, and Z. A. Shaikh, "The role of blockchain in finance beyond cryptocurrency: trust, data management, and automation," *Ieee Access*, vol. 12, pp. 64 861–64 885, 2024.

[13] A. Pambudi, N. Lutfiani, M. Hardini, A. R. A. Zahra, and U. Rahardja, "The digital revolution of startup matchmaking: Ai and computer science synergies," in *2023 Eighth International Conference on Informatics and Computing (ICIC)*. IEEE, 2023, pp. 1–6.

[14] Y. Affandi, M. M. Ridhwan, I. Trinugroho, and D. H. Adiwibowo, "Digital adoption, business performance, and financial literacy in ultra-micro, micro, and small enterprises in indonesia," *Research in International Business and Finance*, vol. 70, p. 102376, 2024.

[15] G. H. Sagala and D. Őri, "Exploring digital transformation strategy to achieve smes resilience and antifragility: a systematic literature review," *Journal of Small Business & Entrepreneurship*, vol. 37, no. 3, pp. 495–524, 2025.

[16] T. Hongsuchon, U. Rahardja, A. Khan, T.-H. Wu, C.-W. Hung, R.-H. Chang, C.-H. Hsu, and S.-C. Chen, "Brand experience on brand attachment: The role of interpersonal interaction, feedback, and advocacy," *Emerging Science Journal*, vol. 7, no. 4, pp. 1232–1246, 2023.

[17] N. Nurhayati and A. D. Astono, "The mediating role of digital transformation in the effect of dynamic capabilities on business resilience," *JDM (Jurnal Dinamika Manajemen)*, vol. 15, no. 1, pp. 41–54, 2024.

[18] U. Rahardja, S.-C. Chen, Y.-C. Lin, T.-C. Tsai, Q. Aini, A. Khan, F. P. Oganda, E. R. Dewi, Y.-C. Cho, and C.-H. Hsu, "Evaluating the mediating mechanism of perceived trust and risk toward cryptocurrency: An empirical research," *SAGE Open*, vol. 13, no. 4, p. 21582440231217854, 2023.

[19] E. Yuliyanti, A. Turmudhi, T. Sumiyanti, A. N. Rosyid, and Z. R. Fadhila, "Digital financial innovation and msmes'sustainable performance in developing countries: A prisma-based systematic review," *Journal of Economics Research and Policy Studies*, vol. 6, no. 2, pp. 411–431, 2026.

[20] H. E. Riwayati, H. A. Rachman, S. Pramesworo, N. Yustisia, H. Umar, and M. Siahaan, "Unveiling the dynamics of financial literacy and inclusion in women digital loan decision making," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 7, no. 3, pp. 986–998, 2025.

[21] Y. Said, A. mahdi Khaddar, L. Hassine, A. Eddaoui, and T. Chafiq, "The impact of blockchain on the banking sector: A systematic review of applications, challenges, and future directions," *Asia and the Global Economy*, vol. 6, no. 1, p. 100133, 2026.

[22] A. Ruangkanjanases, A. Khan, O. Sivarak, U. Rahardja, S.-W. Chien, and S.-C. Chen, "The magic of brand experience: A value co-creation perspective of brand equity on short-form video platforms," *Emerg. Sci. J*, vol. 7, no. 5, pp. 1588–1601, 2023.

[23] E. Setiawaty, H. Hartoyo, R. Nurmalina, and L. N. Yuliati, "Entrepreneurship and innovation in telemedicine adoption among physicians in indonesia," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 7, no. 3, pp. 927–941, 2025.

[24] G. D. Sharma, A. K. Tiwari, R. Chopra, and D. Dev, "Past, present, and future of block-chain in finance," *Journal of Business Research*, vol. 177, p. 114640, 2024.

[25] A. Rizky, M. Ramaditya, and A. A. Kamal, "Leveraging big data analytics to strategically expand digital microcredit access for msmes," *ADI Journal on Recent Innovation (AJRI)*, vol. 7, no. 1, pp. 13–24, 2025.

[26] M. R. Rita and P. K. Y. Nastiti, "The influence of financial bootstrapping and digital transformation on financial performance: Evidence from msmes in the culinary sector in indonesia," *Cogent Business & Management*, vol. 11, no. 1, p. 2363415, 2024.

[27] M. Javaid, A. Haleem, R. P. Singh, R. Suman, and S. Khan, "A review of blockchain technology applications for financial services," *BenchCouncil transactions on benchmarks, standards and evaluations*, vol. 2, no. 3, p. 100073, 2022.

[28] D. Cahyono, A. Susbiyani, E. Lestari, F. Fauziyah, N. Qomariah, and Y. S. Guntur, "Role of personal savings in financial tech impact on family planning in indonesia," *Aptisi Transactions on Technopreneurship (ATT)*, vol. 7, no. 1, pp. 120–131, 2025.

[29] R. Patel, M. Migliavacca, and M. E. Oriani, "Blockchain in banking and finance: A bibliometric review," *Research in International Business and Finance*, vol. 62, p. 101718, 2022.

[30] T. Renduchintala, H. Alfauri, Z. Yang, R. D. Pietro, and R. Jain, "A survey of blockchain applications in the fintech sector," *Journal of Open Innovation: Technology, Market, and Complexity*, vol. 8, no. 4, p. 185, 2022.

[31] Y. R. C. Pujiharto, T. Mariyanti, A. R. Jayaprawira, and Y. A. Terah, "Financial management of indonesian hajj against the yield by using a dynamics system model," *APTISI Transactions on Management*, vol. 7, no. 1, pp. 69–78, 2023.

[32] European Commission. (2026, May) Crypto-assets. Directorate-General for Financial Stability, Financial Services and Capital Markets Union. [Online]. Available: https://finance.ec.europa.eu/digital-finance/crypto-assets_en

[33] G. Ernestivita and S. Subagyo, "Digital transformation, marketing, business size, financial literation on smes'competitive advantage," *Trikonomika*, vol. 22, no. 2, pp. 100–107, 2023.

[34] S. Miko, A. W. T. Atmaja, R. Mawardah, S. D. Zulfa, F. Siboro, and A. Marjuki, "The impact of competitiveness, information technology, risk perception, and financial literacy on the intention to invest in cryptocurrency," *IAIC Transactions on Sustainable Digital Innovation (ITSDI)*, vol. 5, no. 1, pp. 1–7, 2023.

[35] H. D. C. Korompis, D. P. E. Saerang, and S. J. C. Wangke, "The influence of financial literacy and financial attitude on financial resilience of micro, small, medium enterprises (msmes) in manado," *Jurnal Emba Jurnal Riset Ekonomi Manajemen Bisnis Dan Akuntansi*, vol. 11, no. 3, pp. 371–380, 2023.

[36] O. Guelida, S. Jai Andaloussi, and O. Ouchetto, "Smart contracts in finance and banking systems in the era of industry 5.0: A systematic review," *Industry 5.0 and Emerging Technologies: Transformation Through Technology and Innovations*, pp. 317–346, 2024.

[37] R. Wirdiyanti, I. Yusgiantoro, A. Sugiarto, A. D. Harjanti, I. Y. Mambea, S. Soekarno, and S. M. Damayanti, "How does e-commerce adoption impact micro, small, and medium enterprises' performance and financial inclusion? evidence from indonesia," *Electronic Commerce Research*, vol. 23, no. 4, pp. 2485–2515, 2023.

[38] M. A. Yakhlf, "Improving cash-flow forecasting accuracy in inflationary environments through predictive analytics," *Almarifa Journal*, pp. 1–11, 2026.

[39] S. A. Lasut, S. F. Mokoagouw, Y. H. Rumengan, and I. K. S. Arsana, "Financial management capability and smes performance: The mediating roles of cash flow control and financial resilience," *Indonesian Journal of Taxation and Accounting*, pp. 121–137, 2026.

[40] T. Beck and A. Demirguc-Kunt, "Small and medium-size enterprises: Access to finance as a growth constraint," *Journal of Banking & finance*, vol. 30, no. 11, pp. 2931–2943, 2006.

[41] I. Bawono, E. Maulina, M. Rizal, and M. Purnomo, "The role of knowledge management capability, financial literacy, and problem-solving skills on organizational performance for smes," *Frontiers in Psychology*, vol. 13, p. 930742, 2022.

[42] I. Moridu, N. H. Posumah, and F. Fitriani, "Financial risk, managerial capability, and msme business resilience in an era of economic uncertainty," *Journal of Economics, Entrepreneurship, Management Business and Accounting*, vol. 4, no. 4, pp. 1596–1631, 2026.

[43] M. F. Siregar, M. H. A. Nasution, E. U. B. Sidabutar, V. Panjaitan, and E. J. Tarigan, "Financial resilience of indonesian smes amid economic uncertainty: The roles of accounting information quality, financial management capability, and strategic agility," *Golden Ratio of Data in Summary*, vol. 6, no. 3, pp. 944–956, 2026.

[44] K. Ratnawati, R. Rokhim, C. R. Wati, and P. P. Dewanta, "The impact of enhancing digital financial literacy on firm performance: Evidence from digitalisation in indonesia," *International Journal of Technology Intelligence and Planning*, vol. 14, no. 1, pp. 78–106, 2025.

[45] C. Tandilino, G. T. Pontoh, D. Darmawati, and A. Indrijawati, "Digital financial inclusion as a mediator of digital financial literacy and government support in msme performance," *International Journal of Financial Studies*, vol. 13, no. 4, p. 199, 2025.

[46] A. F. D. Sandi and Y. E. Damayanti, "The influence of financial literacy and financial technology on the financial behavior of students of the management study program, raden rahmat islamic university, malang," *International Journal of Advances in Engineering and Management (IJAEM)*, vol. 6, no. 11, pp. 621–625, 2024.

[47] M. J. F. Esomar, S. Sumiati, R. Wijayanti, and S. Aisjah, "Digital financial literacy and resilience in msmes: a bibliometric systematic literature review," pp. 1–30, 2025.

[48] M. A. H. H. Noor and S. Sriyono, "Empowering msmes globally with digital literacy and financial resilience strategies: Memberdayakan umkm secara global dengan literasi digital dan strategi ketahanan finansial," *Indonesian Journal of Law and Economics Review*, vol. 19, no. 2, pp. 10–21 070, 2024.

[49] G. P. L. Permana, I. P. B. A. Wicaksana, and N. J. Mohaidin, "Measuring financial inclusion in smes: A pathway to strengthening financial resilience," *Akurasi: Jurnal Studi Akuntansi dan Keuangan*, vol. 8, no. 2, pp. 477–500, 2025.

[50] M. I. Fairuzi, W. E. Pujianto, A. L. Larassaty, and A. Sholikhah, "Building resilient entrepreneurship: How financial literacy and digital inclusion drive performance in smes?" *Jurnal Manajemen Dan Organisasi*, vol. 16, no. 2, pp. 177–197, 2025.

[51] Y. I. Mahjoub, M. Hassoun, and D. Trentesaux, "Blockchain adoption for smes: opportunities and challenges," *IFAC-PapersOnLine*, vol. 55, no. 10, pp. 1834–1839, 2022.

[52] C.-H. Tsai, D.-K. Liou, and H.-L. Lee, "Blockchain-supported online banking scheme," *Egyptian Informatics Journal*, vol. 27, p. 100516, 2024.

[53] A. Alamsyah, G. N. W. Kusuma, and D. P. Ramadhani, "A review on decentralized finance ecosystems," *Future Internet*, vol. 16, no. 3, p. 76, 2024.

[54] I. Ariana, I. Wiksuana, I. R. Candraningrat, and I. Baskara, "The effects of financial literacy and digital literacy on financial resilience: Serial mediation roles of financial inclusion and financial decisions," *Uncertain Supply Chain Management*, vol. 12, no. 2, pp. 999–1014, 2024.