Trustworthy Artificial Intelligence and Financial Inclusion among Digital Financial Service Users in Nigeria

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ABSTRACT

The increasing integration of artificial intelligence (AI) into digital financial services presents opportunities for expanding financial inclusion in Nigeria, but concerns about transparency, fairness, privacy, and security may influence users' willingness to engage with AI-enabled financial platforms. This study examines the effect of Trustworthy Artificial Intelligence on financial inclusion among digital financial service users in Nigeria. Specifically, the study evaluates the effects of AI transparency, AI fairness, and AI privacy and security on financial inclusion. A quantitative research design was adopted, and primary data were collected through a structured questionnaire from 350 users of digital financial services. The data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS 4. The measurement model demonstrated satisfactory reliability, convergent validity, and discriminant validity. The findings reveal that AI transparency has a significant positive effect on financial inclusion ($\beta = 0.177$, $p = 0.014$). AI privacy and security also has a significant and stronger positive effect on financial inclusion ($\beta = 0.557$, $p < 0.001$). However, AI fairness has a positive but statistically insignificant effect on financial inclusion ($\beta = 0.124$, $p = 0.139$). The study concludes that secure and transparent AI-enabled financial services are particularly important for promoting financial inclusion in Nigeria. Financial institutions and FinTech providers should therefore strengthen data protection, cybersecurity, transparency, and responsible AI governance to enhance users' confidence and participation in digital financial services.

Keywords: Trustworthy Artificial Intelligence, AI Transparency, AI Fairness, Privacy and Security, Financial Inclusion, Digital Financial Services.

1. INTRODUCTION

Artificial Intelligence is one of the major technologies that has driven digital transformation in all sectors and is changing how organisations operate, decide and deliver value. In the financial services industry, AI has transformed traditional banking practices by providing support for credit assessment, detecting fraud, effective management of customer relationships, ensuring compliance with regulations, managing risks and eliminating risks and also personalising financial services. The further proliferation of financial technology (FinTech), mobile banking, digital payment platforms and agency banking have increased the adoption of AI into the financial ecosystem to allow financial institutions to use AI solutions to improve operational efficiency and lower service delivery costs (Fritz-Morgenthal et al., 2022; Abdulquadri et al., 2021; Ogundele et al., 2025). Consequently, AI is increasingly recognised as a resource to drive competitiveness and sustainable growth in the financial sector, not just as a technology. The growing use of artificial intelligence (AI) in Nigeria has attracted policy attention, and this is reflected in initiatives like the National Artificial Intelligence Strategy and the Nigeria Data Protection Act (2023), which both seek to encourage responsible AI deployment and enhance consumer confidence in digital technologies. The increasing use of artificial intelligence has changed how

banks and other financial institutions engage with customers and conduct financial transactions. Smart algorithms are increasingly used nowadays for financial decision making, predicting customer behaviour, spotting fraud, optimising lending decisions and ensuring regulatory compliance. As a result of these capabilities, there have been improved service efficiencies and operational performance with increased opportunities for financial innovation (Ogundele et al., 2025; Adedire-Ampitan et al., 2024). However, as AI systems become more embedded in financial decision making, the concerns about algorithmic decision transparency, automation fairness, customer data protection and overall trust in AI-driven financial services have grown in size and also sophistication. It's ideal for an artificial intelligence application to be interpreted and explainable. Unlike classical information systems, lots of artificial intelligence applications are complex "black box" models, making it hard for users to understand their decision processes. That raises concerns of accountability, explainability, ethical use and regulation (Fritz-Morgenthal et al., 2022; Afroogh et al., 2024).

Scholars have turned their attention to Trustworthy Artificial Intelligence because of such concerns. Trustworthy AI places strong emphasis on transparent, fair, secure and aligned systems that are accountable, explainable and other attributes besides sheer technological performance. According to Díaz Rodríguez et al. (2023), it is necessary to implement a practical governance mechanism that ensures transparency, fairness, accountability, protection and human oversight of privacy throughout the AI lifecycle. Likewise, Fritz-Morgenthal et al. (2022) hold that explainability, fairness, transparency, privacy, auditability and effective governance are all critical requirements for deploying AI in heavily regulated sectors, such as banking, where decisions made by algorithms can directly impact customers' financial wellbeing. The various dimensions of Trustworthy Artificial Intelligence have been identified, among which AI transparency, AI fairness, and AI privacy and security are also deemed especially important. These dimensions are ones that directly impact users' confidence in AI-enabled financial services. When AI understands customer needs, it can deliver insights that will make them feel at home. Transparency helps customers know how AI gives recommendations and makes decisions about finances. Fairness refers to minimizing the bias and discrimination that could get generated by AI. It seeks to ensure that stakeholders will not get unfairly discriminated against or affected by the activities of the AI system. Privacy and security involves protecting your stakeholders with regards to the privacy of their financial and personal information. It protects the customers against cyber threats, the misuse of information, and unauthorized access. Taking them all together will help to form trustworthy AI systems that can boost user trust and enhance the adoption of AI-enabled financial services (Fritz-Morgenthal et al., 2022; Yaseen & Al-Amarneh, 2025; Afroogh et al., 2024). Trustworthy Artificial Intelligence is notably relevant in developing economies such as Nigeria where financial inclusion is a significant national development priority. In the last ten years, Nigeria has grown a lot in digital financial services through commercial banks, fintech companies, digital wallets, mobile banking apps, and agent banking networks. As a result of these technological innovations, access to formal financial services has expanded significantly, and government efforts to promote financial inclusion have been supported. According to Omankhanlen et al. (2025), the capacity of AI applications to facilitate holistic financial inclusion capable of providing the poor with the access to affordable financial services, the efficiency of services and delivery of the inclusive financial products will be increased. According to Abdulquadri et al. (2021), customer engagement has improved significantly with AI-enabled technologies like chatbots, resulting in improved quality financial service delivery by financial institutions in Nigeria.

Fintech is one of the technological advancements that Nigerians are pinning hope on. Despite the increased availability of digital financial services, concerns about cyber fraud, misuse of personal information, algorithmic bias and opaque AI decisions, and inadequate protections for customer data still dissuade many people from fully utilizing AI-enabled financial services. Recent Study have been able to show that AI has enhanced operational efficacy in Nigerian banks however trust issues and governance of AI and ethical AI implementation are issues to not sustainable adoption (Obizue et al., 2025) According to Nnaomah et al. (2024), AI has, indeed, strengthened the practices of risk management by banks within Nigeria. However, the effective application would depend on governance structures that could ensure reliability, transparency, and stakeholder confidence. These concerns indicate that mere expansion of digital financial services will not guarantee achieving sustainable financial inclusion unless the users find AI-powered financial systems trustworthy. Existing empirical studies have examined AI on various fronts in the financial services sector. Prior studies have explored diverse areas related to the adoption of AI in banking, focusing on fraud detection,

customer service automation, and digital transformation. Other areas include credit risk management, operational efficiency, financial performance, mobile banking, and banking risk management (Muhammad et al., 2025; Odonkor et al., 2024). Several other studies have looked into how AI contributes to financial inclusion, exploring how it can enhance access to financial products and services among underserved populations (Adeoye et al, 2024; Priya et al, 2025). Kaur and colleagues, along with Li and others, have been examining flavours of Trustworthy AI from ethical, governance, explainability, transparency, and regulatory perspectives. These studies have made notable improvements to the knowledge of AI in the financial services at the same time as they have provided little empirical evidence on the manner in which the essential dimensions of Trustworthy Artificial Intelligence influence financial inclusion in developing economies.

The existing literature has exposed some gaps. To begin with, trustworthy AI is mostly examined from the perspective of AI adoption, fraud detection, explainability, governance, organisational performance or customer trust rather than financial inclusion (Lukyanenko et al., 2022; Rao, 2025) in most of the empirical studies. In the second place, research papers that jointly examine the AI transparency, AI fairness and AI privacy and security as the core dimensions of Trustworthy Artificial Intelligence in a single empirical framework are limited (Li et al. 2022; Nils 2024). In recent Nigerian studies on the topic of AI adoption, digital financial services, and financial inclusion, most attention has been on operational efficiency, customer service, AI-enabled credit systems and organisational outcomes. Very little has been on how AI transparency, AI fairness and AI privacy and security jointly affect financial inclusion of users of digital financial services (Ehimare, 2022; John et al., 2026). In addition, there is a dearth of studies that employ Structural Equation Modelling (SEM) and primary survey data to examine these relationships among AI-enabled financial services users (Lal et al., 2025; Rabbani et al., 2023). In this regard, this study investigated the effect of Trustworthy Artificial Intelligence on financial inclusion in Nigeria. In other words, whether the transparency of AI, fairness of AI, as well as the privacy and security of AI significantly impact financial inclusion. This study focuses on the users of digital financial services. In particular, the study seeks to establish the effect of AI transparency on financial inclusion, determine the effect of AI fairness on financial inclusion, and evaluate the effect of AI privacy and security on financial inclusion in Nigeria. As a result, the study shall test the following null hypotheses H01: AI transparency has no significant effect on financial inclusion in Nigeria; H02: AI fairness has no significant effect on financial inclusion in Nigeria; and H03: AI privacy and security has no significant effect on financial inclusion in Nigeria.

Through the integration of Trustworthy AI three-dimensions into one being in the growing literature on AI-enabled financial services and financial inclusion, this study extends literature in the context of Nigeria using Technology Acceptance Model (TAM). The results are expected to be useful to the concerned stakeholders such as financial institutions, technology developers (including those in fintech), regulators, and policy-makers; who are keen on designing AI-enabled financial systems that enhance public confidence, and stimulate broader participation in the formal space of financial services (including all segments), and augment sustainable digital financial development.

2. LITERATURE REVIEW

2.1 Conceptual Review

Artificial intelligence is one of the most crucial technological innovations fuelling digital transformation within the financial services sector. As financial intermediaries are looking to make their routine tasks more efficient, they are aggressively deploying artificial intelligence (AI) to enhance the operational efficiency of their organization. The capability of artificial intelligence to efficiently sift through and analyze enormous data sets is increasingly being employed by banks to examine customer behavior and predict future transactions. According to Fritz-Morgenthal et al. (2022), AI has gone beyond automation to become a critical component of financial risk management, facilitating decision-making in credit risk, anti-money laundering, fraud detection, customer relationship management, and regulatory compliance. The growing evidence of the reliance of financial organisations on intelligent technologies (AI) is happening because of increased efficiency, operational effectiveness, customer satisfaction, and service experiences in financial institutions in Nigeria (Ogundele et al. 2025). The increasing use of AI in the financial services space has evoked rising

concerns about the reliability and trustworthiness of these systems. Many AI models depend on advanced machine learning systems that frequently do not provide an explanation for how they have reached a particular conclusion unlike traditional information systems. Concerns about fairness, accountability, privacy, explainability and ethical governance have arisen from this opacity. According to Fritz-Morgenthal et al. (2022), financial institutions must not focus solely on predictive accuracy; rather, they should ensure that the AI systems are transparent, explainable, auditable and free from harmful bias. According to Afroogh et al. (2024), trust is one of the strongest determinants of acceptance of AI. In particular, users will not accept an intelligent system whose decisions are not understandable or whose reasoning cannot be justified. Consequently, researchers' focus has shifted away from AI adoption studies toward AI characteristics that can be deemed trustworthy. As a result, trustworthy AI has emerged as an important topic in modern AI governance. Trustworthy AI refers to the realization of ethical AI principles through governance frameworks that can promote transparency, accountability, fairness, privacy, security, and human oversight throughout the AI life cycle. (Díaz Rodríguez et al., 2023). Much the same way earlier studies show that explainability, fairness, transparency, privacy preservation, auditability and good governance together assure trust in deployment of AI systems, especially in heavily regulated industries such as banking where automated decisions affect customers' financial wellbeing. As opposed to technological performance only, Trustworthy AI brings responsible innovation to the fore – guaranteeing intelligent systems deliver reliable outcomes while safeguarding users against algorithmic risks.

Of all the dimensions of Trustworthy Artificial Intelligence, AI transparency has received quite a bit of attention as it enables a better understanding of how AI systems formulate recommendations and arrive at decisions. Transparent AI systems build user trust and foster accountability by offering understandable explanations for automated outcomes and processes. According to studies, as customers increasingly demand explanations relating to decisions on loan approval, credit scoring and financial risk assessment, explainability and transparency are an important requirement in AI applications used for financial decision making. Similarly, Yaseen and Al-Amarneh (2025) revealed that transparency may foster trust in AI fraud detection. Consequently, users might utilize AI in a process perceived as clear and open. Another important dimension of Trustworthy Artificial Intelligence is AI fairness, as AI-generated financial decisions will impact the economic opportunities and social welfare of individuals. Fair AI systems minimize algorithmic bias and discrimination by optimally treating individuals irrespective of their gender, ethnicity, income level or other demographic characteristics. Fairness is more than mere technical accuracy, argue previous studies. AI systems, they assert, must not only be non-discriminatory in their outcomes, but also accountable for their decisions, in a formal and substantive sense. Likewise, Yaseen and Al-Amarneh (2025) show fairness perceptions positively affect users' confidence in banking systems with AI, meaning customers are willing to trust financial institutions adopting fair and unbiased AI technologies. Due to high profile security breaches and hacks, data privacy and security is a fundamental requirement for Trustworthy Artificial Intelligence. The customer confidence in AI-enabled financial services heavily depends on their ability to collect, store and analyze personal and financial data. As a result, data protection and cyber security become significant determinants. Privacy protection is a fundamental principle of Trustworthy AI, according to Díaz Rodríguez et al. (2023), while the deployment of AI in financial institutions must entail ample use of responsible technologies as well as strong governance mechanisms (Iezzi et al., 2023). To keep users' trust intact in AI-enabled financial services, cyber threats have to be constantly safeguarded for protecting customer data.

The significance of Trustworthy Artificial Intelligence is increasingly being recognized, especially concerning Financial Inclusion. Financial inclusion refers to the ability of individuals and businesses to access and use affordable financial products and services effectively. Financial inclusion ensures access to a variety of financial products and services such as credit, savings, and insurance. Access to savings, credit, insurance, digital payments, and investment services helps poor people participate in the economy. It also helps in poverty reduction and inclusive economic growth. Akanfe et al. (2025) believe that applications of AI have great scope to enhance financial inclusion by improving accessibility and efficiency, and delivery of financial services to unserved populations. According to David et al. (2024), similarly, AI strengthens customer trust, digital financial service security and quality as well as improves accessibility, thus contributing to financial inclusion. Transparency of AI, fairness of AI, AI privacy and security together represent complementary dimensions of Trustworthy Artificial Intelligence. Transparency helps users understand the rationale behind

automated decisions; fairness reinforces perceptions of equitable treatment; and privacy and security protect users' personal and financial information, all serving to enhance confidence in AI-enabled financial services. Thus, they are required to promote a greater engagement in formal financial systems and enhance financial inclusion

2.2 Theoretical Review

Technology Acceptance Model (TAM)

The growing relationship between Trustworthy Artificial Intelligence and financial inclusion can be further explained through the Technology Acceptance Model (TAM) developed by Davis (1989). The model proposes that individuals are more likely to adopt and continue using technology when they perceive it as useful and easy to use. Although TAM was originally developed to explain technology adoption, its underlying assumptions provide an appropriate theoretical foundation for this study because users' perceptions of AI transparency, fairness, and privacy and security influence their willingness to trust and continuously utilise AI-enabled financial services. Within the context of this study, AI transparency enhances users' understanding of AI-enabled financial services, AI fairness strengthens perceptions of equitable treatment, while AI privacy and security increase confidence in the protection of personal and financial information. These perceptions improve users' acceptance and continued use of AI-enabled financial services, thereby promoting financial inclusion. Consequently, the Technology Acceptance Model provides an appropriate theoretical lens for explaining how the dimensions of Trustworthy Artificial Intelligence influence financial inclusion in Nigeria.

2.3 Empirical Review

Despite the fact that available empirical evidence demonstrates the contribution of artificial intelligence within the financial services, findings are still quite fragmented as previous studies have focused on organizational performance, operational efficiency, front-end services, fraud detection, banking risk management, technology adoption and much more than users' perception on Trustworthy Artificial Intelligence. According to Abdulquadri et al (2021), chatbots powered by AI can engage customers and deliver services at financial institutions in Nigeria. According to an additional article by Demirel and Topcu (2024), AI applications positively influence mobile banking growth by enhancing customer experience and strengthening service efficiency. According to Adedire-Ampitan et al. (2024), AI greatly improves risk management systems among deposit money banks in Nigeria. Similarly, Ogundele et al. (2025) found that the ability of AI to enhance operational efficiency and customer service delivery leads to sustainable banking. The use of AI in credit management is crucial in improving the financial performance of the deposit money banks (Isaac and Jimoh, 2025). Taken together, these studies reveal the sizable positive impact of AI on banking performance, but have little focus on Trustworthy Artificial Intelligence as a multidimensional construct impacting financial Inclusion. Likewise, the works of Omankhanlen et al. (2025) and Goyal and Renu (2026) show that AI has a positive relationship with financial inclusion. However, neither of these studies examines Trustworthy Artificial Intelligence through the lenses of AI transparency, AI fairness, and AI privacy and security using a common analytical framework. Many researchers (e.g., Fritz-Morgenthal et al. 2022; Díaz-Rodríguez et al. 2023; Afroogh et al. 2024; Yaseen and Al-Amarneh 2025) have focused mainly on explainability, governance, ethics, transparency, fairness, and trust in the adoption of AI. But none investigated the combined effect of these on financial inclusion in Nigeria. As can be seen from the above literature, while some knowledge has been built regarding the application of artificial intelligence in financial services, key conceptual and methodological issues remain. Research to date has focused mostly on governance, explainability, ethics, fraud detection, organizational performance, customer trust, and technology adoption. However, limited empirical attention has focused on the role of trustworthy artificial intelligence in the context of financial inclusion. In addition, while recent studies have examined AI adoption and financial inclusion within Nigeria, not many have examined Trustworthy Artificial Intelligence as a multidimensional construct which includes AI transparency, AI fairness, AI privacy and security. There are limited empirical studies applying Structural Equation Modelling (SEM) to investigate the joint effects of these dimensions on financial inclusion of the users of digital financial services. This study aims to fill these conceptual and methodological gaps by

examining the impact of ai transparency, ai fairness and ai privacy and security on financial inclusion in Nigeria's digital finance space.

3. METHODOLOGY

A quantitative research strategy was adopted to assess the effect of Trustworthy Artificial Intelligence on financial inclusion of Digital Financial Service Users in Nigeria. The quantitative was deemed relevant as the method which enables primary data collection from users of digital financial services. And the statistical examination of relationships amongst the study variables. To gather primary data from respondents, a structured questionnaire was used for study. The group of study participants was Nigerian adults who access any digital financial services. These include mobile banking applications, internet banking, digital wallets, fintech platforms, agency banking services, and other AI-powered financial services. For the study, 350 respondents were sampled using a purposive sampling method. The analytical technique employed and the relationships among the study variables were sufficiently large for the sample size adopted.

The questionnaire used a 5-point Likert scale which ranged from Strongly Disagree (1) to Strongly Agree (5). Nineteen items measured AI transparency; AI fairness; AI privacy and security; and financial inclusion. The respondents were requested to express their level of agreement with the statements based on their experience with digital financial services. The analysis of the data was accomplished with use of Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS 4. This technique was considered appropriate in view of the fact that it allows for the simultaneous evaluation of measurement models and structural relationships among latent constructs. The article defined Financial Inclusion (FI) as the dependent variable, whereas AI Transparency (AIT), AI Fairness (AIF), and AI Privacy Security (AIPS) were defined as the independent variables signifying the dimensions of Trustworthy AI.

The relationship between the variables is represented as:

$$FI = f(AIT, AIF, AIPS)$$

The structural model is specified as:

$$FI = \beta_0 + \beta_1 AIT + \beta_2 AIF + \beta_3 AIPS + \varepsilon$$

The model indicates that financial inclusion emerges from being transparent, fair as well as private and secure in the AI. As a result, the research intended to investigate the impact of these dimensions of Trustworthy Artificial Intelligence on financial inclusion among digital financial service customers in Nigeria. The variables under study were measured on a structured questionnaire by the respondents. The tool was divided in two sections. Section A collected data on the demographic characteristics of respondents such as gender, age, educational qualification, nature of occupation, type of digital financial service used, duration of usage, and frequency of usage. The main constructs of the study were measured in Section B. Items concerning the clarity, understandability and openness of AI-enabled financial decisions measured AI transparency. AI fairness was measured via items indicating AI-enabled financial services' fair, unbiased, and non-discriminatory treatment of users. The extent to which users' personal and financial data are protected by the respective systems and the extent to which AI-enabled fintech service is secure. Financial inclusion was measured through items on access, usage as well as participation in formal financial services. The items were adapted from literature focusing on Trustworthy Artificial Intelligence and AI-enabled financial services as well as financial inclusion with appropriate modifications to suit the Nigerian digital financial services contexts. The instrument is verified by looking at Cronbach Alpha, Composite Reliability, Average Variance Extracted, Fornell-Larcker Criterion and Heterotrait-Monotrait Ratio.

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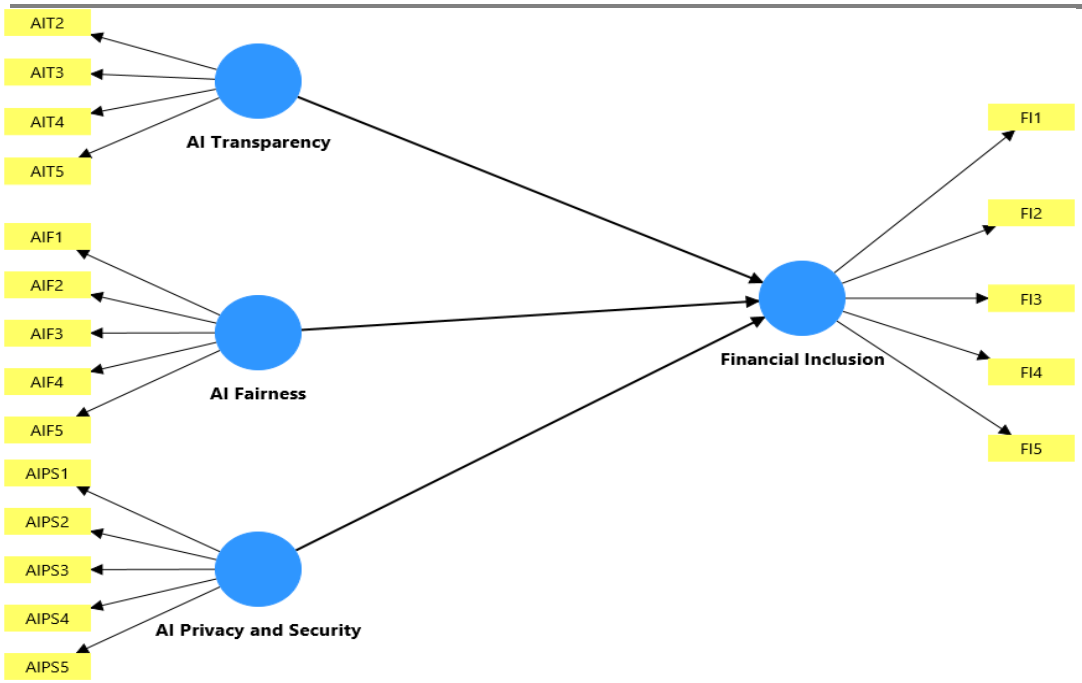

Figure 1: Conceptual Framework

Source: Authors Computation (2026)

4.0 RESULTS

TABLE 1: Measurement Model Assessment (Outer Loadings)

	AI Fairness	AI Privacy and Security	AI Transparency	Financial Inclusion
AIF1	0.905			
AIF2	0.907			
AIF3	0.922			
AIF4	0.891			
AIF5	0.907			
AIPS1		0.901		
AIPS2		0.909		
AIPS3		0.94		
AIPS4		0.909		
AIPS5		0.935		
AIT2			0.748	
AIT3			0.835	
AIT4			0.891	
AIT5			0.923	
FI1				0.923
FI2				0.921
FI3				0.936
FI4				0.93
FI5				0.896

Source: Authors Computation (2026)

The outer loading results in table 4.1 above indicate the measurement items show a sufficiently strong indicator reliability for AI Fairness, AI Privacy and Security, AI Transparency and Financial Inclusion. The outer loadings for AI Fairness (AIF1–AIF5) are between 0.891 and 0.922. All are above the recommended threshold of 0.70. Likewise, the AI Privacy and Security indicators (AIPS1-AIPS5) have an equal loading range of 0.901-0.940 signifying a very strong relationship between the indicators and the latent construct. The loadings for the retained indicators (AIT2–AIT5) associated with AI Transparency range from 0.748–0.923. Despite AIT2's low loading (0.748), it is still above the acceptable 0.70 threshold and was thus retained. The loadings of Financial Inclusion indicators FI1–FI5 are 0.896 to 0.936 that confirm their satisfactory indicator reliability. Indicators that were retained were adequate representations of their latent constructs.

AIT1 was eliminated due to its outer loading being below the acceptable threshold for the reliability of the indicator. In PLS-SEM, an indicator with a loading less than 0.70 is typically removed,especially when its deletion enhances the construct's reliability and convergent validity. Thus, removing AIT1 was appropriate to enhance the measurement quality of AI Transparency.

TABLE 2: Reliability and Convergent Validity of the Measurement Model

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
AI Fairness	0.946	0.947	0.958	0.822
AI Privacy and Security	0.954	0.955	0.964	0.844
AI Transparency	0.875	0.917	0.913	0.726
Financial Inclusion	0.955	0.956	0.966	0.849

Source: Authors Computation (2026)

The findings for the construct reliability and validity in table 2 above have confirmed that all the constructs showed satisfactory internal consistency and convergent validity. The acceptable limits of not less than 0.70 for the Cronbach's alpha should be the standard benchmark achieved. Likewise, rho_A values varied between 0.917 and 0.956, while the composite reliability (rho_C) ranged between 0.913 and 0.966. The findings indicate that an indicator consistently measures its latent construct. Moreover, AVE values for AI Fairness, AI Privacy and Security, AI Transparency and Financial Inclusion are 0.822, 0.844, 0.726 and 0.849 respectively. The value of everything is much above the minimum recommended target of 0.50. Thus it demonstrates adequate convergent validity. This shows the measurement model is sufficiently reliable and valid. As such, AI Fairness, AI Privacy and Security, AI Transparency and Financial Inclusion constructs are deemed suitable for the assessment of structural model and hypothesis testing using PLS-SEM.

Discriminant Validity

This ensures that each latent variable is unique and not measuring the same concept as another variable. This assessment was carried out using the Fornell-Larcker Criterion and the Heterotrait-Monotrait Ratio (HTMT).

Table 3: Heterotrait-monotrait ratio (HTMT) – Matrix

	AI Fairness	AI Privacy and Security	AI Transparency	Financial Inclusion
AI Fairness				
AI Privacy and Security	0.766			
AI Transparency	0.637	0.75		
Financial Inclusion	0.757	0.721	0.709	

Source: Authors Computation (2026)

The Heterotrait-Monotrait ratio (HTMT) presented in table 3 above provides evidence of discriminant validity among the constructs of the measurement model. The values of HTMT for AI Fairness with AI Privacy and Security and for AI Fairness with AI Transparency are 0.766 and 0.637 respectively. Likewise, AI Privacy and Security and AI Transparency have an HTMT value of 0.750. In terms of Financial Inclusion, the values of HTMT are 0.757 with AI Fairness, 0.721 with AI Privacy and Security and 0.709 with AI Transparency. All reported results of HTMT are below the threshold limit of 085 which means that each construct is distinct from the other in terms of empirical generation. The maximum 0.766 observed between AI Fairness and AI Privacy and Security is well below the cut off. Consequently, these results confirm that the constructs are sufficiently distinct concepts and do not measure the same thing. The HTMT outcomes confirm that adequate discriminant validity is present, thereby allowing the testing of the structural model and the hypotheses.

Table 4: Fornell-Larcker criterion

	AI Fairness	**AI Privacy and Security**	**AI Transparency**	**Financial Inclusion**
AI Fairness	0.907			
AI Privacy and Security	0.822	0.919		
AI Transparency	0.783	0.714	0.852	
Financial Inclusion	0.721	0.785	0.671	0.921

Source: Authors Computation (2026)

The results of the Fornell-Larcker criterion shown in Table 4 above show that the constructs have achieved satisfactory discriminant validity. The values along the diagonal, presented in bold, indicate that the square roots of the Average Variance Extracted (AVE) for AI Fairness, AI Privacy and Security, AI Transparency, and Financial Inclusion are 0.907, 0.919, 0.852, and 0.921 respectively. Each diagonal value is greater than the corresponding correlations with other constructs indicating Fornell-Larcker criterion is satisfied. The value of AI Fairness (0.907) as well as its square root is greater than its correlation with AI Privacy and Security (0.822), AI Transparency (0.783) and Financial Inclusion (0.721) In a similar context, AI Privacy and Security shows a diagonal value of 0.919 which is greater than the values of AI Transparency (0.714) and Financial Inclusion (0.785). AI Transparency has a higher correlation than Financial Inclusion does. The outcomes depicted in Table 4 establish that every construct has greater variance with its own indicators than with other constructs. This indicates adequate discriminant validity of the measurement model and supports its use in further structural modelling analysis.

TABLE 5: Hypothesis Testing

The relationships among constructs were tested using bootstrapping (5,000 sub samples). Significance was determined using t-values and p-values.

Path coefficients					
	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
AI Fairness -> Financial Inclusion	0.124	0.131	0.084	1.479	0.139
AI Privacy and Security -> Financial Inclusion	0.557	0.553	0.072	7.752	0
AI Transparency -> Financial Inclusion	0.177	0.175	0.072	2.467	0.014

Source: Authors Computation (2026)

The outcomes of hypothesis testing reveal the effects of Trustworthy Artificial Intelligence dimensions on financial inclusion and digital spaces among the users of digital financial services in Nigeria. The study found

a positive but not statistically significant relationship between AI Fairness and Financial Inclusion. The path coefficient was found to be 0.124 which was along with a t-statistic of 1.479 and a p-value of 0.139. The findings indicate that AI Fairness does not have a significant effect on Financial Inclusion in Nigeria. Since the p-value is higher than the significance level of 0.05, H0 cannot be rejected. As a result, we fail to accept the null hypothesis that AI Fairness has no impact on Financial Inclusion. Conversely, it is determined that AI Privacy and Security has a positive and significant effect on Financial Inclusion where this construct reveals path coefficient of 0.557, t-statistics 7.752, and p-value 0.000. Thus, a positive association exists between improvement in privacy and security of AI-enabled digital financial services with financial inclusion. Thus, the null is rejected

In the same way, there is a considerable and positive effect of AI Transparency on Financial Inclusion that has the coefficient of 0.177 and t-static of 2.467 and p-value of 0.014. As such, AI-based financial services with greater transparency will boost financial inclusion significantly. The null hypothesis has been rejected.

4. DISCUSSION OF FINDINGS

This study unearthed the relationship between Trustworthy Artificial Intelligence and Financial Inclusion among digital financial service users in Nigeria. The findings indicate that the three dimensions of Trustworthy AI that are empirically studied are not equally relevant for financial inclusion. The effect of AI fairness on financial inclusion is positive but not statistically significant, while AI transparency and AI privacy and security have major positive effects. This finding indicates that users' choices to engage with and increasingly use digital financial services appear to be more heavily dependent on their ability to comprehend AI-enabled goods and their belief that their personal and financial information is sufficiently protected, rather than on their fairness perceptions alone. First finding suggests that AI transparency positively influences financial inclusion significantly, analysis shows. The findings reveal that the path coefficient of 0.177, t-statistic of 2.467 and p-value of 0.014 reveals that greater transparency in AI-enabled financial services denotes enhanced financial inclusion. The result indicates that digital financial service users are inclined to access and utilise formal financial services when they possess a reasonable understanding of how AI-supported decisions and processes work. Making information available can help in eliminating the doubts that arise because of erratic automated decisions. For example, AI used for credit assessment or fraud detection. When a user is able to understand how the digital financial services operate and are sufficiently open about the operating processes, users will appreciate using it.

The arguments of Fritz-Morgenthal et al. (2022) that underline explainability, transparency and auditability as important requirements for responsible AI in financial services are in line with this finding. It also backs the findings of Yaseen and Al-Amarneh (2025) that transparency strengthens users' trust in AI fraud detection systems. This research shows that transparency is important not just for trust or for technology adoption, but can also lead directly to financial inclusion. In Nigeria, this has become increasingly useful, as digital financial services are being deployed to target people who may be inexperienced with traditional banking. When users cannot figure out why a transaction is flagged, a financial service is denied, or an automated decision is made, uncertainty can dampen continued usage. Transparent AI can help make inclusion a reality by removing related informational barriers to ADFS. The second major finding indicates that AI privacy and security have a strong positive and statistically significant effect on financial inclusion. The coefficient of 0.557 indicates an extremely significant relationship, with t-statistic 7.752 and p-value of 0.000. AI privacy and security is therefore the strongest predictor of financial inclusion among the identified three dimensions. It can be concluded from this that empowerment of users with confidence in respect of personal and financial information will encourage them to use digital services. As AI-enabled financial platforms require high volumes of sensitive customer information to function, users' fears about data breaches, unauthorized access, identity theft, cyber fraud and misuse of private information can significantly impact their willingness to use the services. This finding supports the work of Díaz-Rodríguez et al. (2023), who identify privacy and security as two important principles of Trustworthy AI. This is also consistent with Iezzi et al. (2023), which stresses the importance of privacy-preserving technologies and appropriate governance mechanisms at financial institutions. The outcome strengthens David et al. 's (2024) larger narrative that confident, AI-powered financial systems can bolster confidence among users while incentivising financial inclusion. Within the Nigeria context, the strong coefficient for AI privacy As well as security imply that availability alone may not

enhance inclusion. Users need to think their financial details are secure. Digital financial services can be defined as products and services such as savings, loans and insurance, that are delivered with the help of digital channels. Correspondingly, investment in cyber security, data protection, authentication mechanisms and privacy-preserving AI technologies may be critical for converting availability of digital financial services in actual and sustained financial participation. The finding also has impacts on the Technology Acceptance Model that underpins the study. TAM posits that perceptions about a technology will affect users' acceptance and ultimate use. According to our findings, usage of AI-enabled financial services is affected by privacy and security not as specific attributes but use conditions. Although privacy and security are not original core components of TAM, the current finding showed they will influence how users perceive these services as acceptable and useful. A digital financial service that is efficient but not secure may not gain market acceptance from end-users. Thus, a significant relationship means that trustworthiness characteristics can serve as extra dimensions or variables that can help to enhance TAM when used to explain technology-enabled financial inclusion.

However, our study indicates that AI fairness boosts financial inclusion, albeit with a statistically insignificant effect. The coefficient is equal to 0.124, while the t-statistic was equal to 1.479 and p-value was equal to 0.139. Therefore, this coefficient is positive but does not reach the 5% significance level. In the case of Nigeria, this finding diverges considerably from most studies that we reviewed, particularly those that involve developing countries. Users may prioritize whether a platform is secure and whether its processes are sufficiently comprehensible over whether it is considered completely fair across a range of underlying algorithms. Some users may not have enough knowledge to judge whether an AI system treated them fairly or whether an automated decision has algorithmic bias. Users are less likely to notice fairness as opposed to privacy, security or transparency. A user might perceive a security measure or the information put forth during a digital transaction, while identifying systematic algorithmic discrimination may require a certain level of technical expertise, or possibly information that users do not have. The trivial finding should not be interpreted as evidence that fairness does not matter. It implies that the direct impact of financial literacy on financial inclusion may be weaker than that of privacy, security and transparency.

The findings indicate that Trustworthy AI is multidimensional and its dimensions have varying implications for financial inclusion. The greatest impact was found for AI privacy and security followed by AI transparency. AI fairness was found to have no significant effect. These findings partially confirm the expectation that trustworthy AI features will foster greater participation in formal financial services. Further, they contribute to the literature by going beyond the blanket assertion that AI enhances financial inclusion to identify the specific dimensions of trustworthiness that really matter for digital financial service users in Nigeria. The findings are especially meaningful to the financial ecosystem in Nigeria as the ongoing expansion of mobile banking, fintech platforms, digital wallets, internet banking and other technology-driven services are increasingly exposing users' financial activities to AI-driven environments. According to the evidence, banks and fintech institutions should not only focus on increasing technological functionality. Data protection, cyber security, and transparency in AI-enabled services should also be strengthened. There should be regulatory and governance frameworks that promote responsible AI actions to make automated finance systems more explainable, secure and responsible. While AI fairness is an important ethical goal, the study's marginal direct connection reflects a need for greater user awareness, and clearer mechanisms to allow customers to identify, question and seek redress against potentially unfair automated decisions.

According to empirical evidence, the tamper-proof and trustworthy AI would bring financial inclusion, but the contribution depends on all dimensions. The most powerful factor is AI privacy and security. At the same time, AI transparency also offers a positive contribution. AI fairness does have positive relation to financial inclusion, but does not have statistically significant independent effect. The study's findings, therefore, provide empirical evidence for a nuanced understanding of Trustworthy AI, especially in Nigeria. In this regard, creating secure and transparent AI-enabled financial services may be particularly useful for supporting greater and sustained participation in the formal digital financial system.

5. SUMMARY

The effect of Trustworthy Artificial Intelligence on the financial inclusion of digital financial services users in Nigeria was examined in the study. The effect of AI transparency, AI fairnness and AI privacy and security on financial inclusion is the subject of the research. Researchers also used a quantitative research design with primary data collected using the structure questionnaire that was administered to 350 users of digital financial services. The analysis was done utilizing Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS 4. The measurement model was found to have good indicator reliability, internal consistency, convergent validity, and discriminant validity. The subsequent structural model was used to test the three hypotheses that were formulated. The results show that AI Transparency has a positive significant effect on Financial Inclusion of 0.177 with the p-value of 0.014. Enhanced transparency within AI-enabled financial services may lead to increased participation of users in formal digital financial spheres. The finding of the study reveals that AI privacy and security has a strong and statistically significant positive effect on financial inclusion with a path coefficient of 0.557 and p-value of 0.000. Of the different dimensions investigated, this had the strongest relationship with that dimension highlighting the need to protect users' personal and financial information. Nonetheless, it was found that AI Fairness had a positive coefficient of 0.124, but the p-value of 0.139 was not significant as it was greater than 0.05. The results reveal that secure and transparent financial services enabled through AI would significantly enhance the strength of financial inclusion in Nigeria.

6. CONCLUSION

The study asserts that Trustworthy Artificial Intelligence plays an important, albeit differentiated, role in advancing the financial inclusion of digital financial service users in Nigeria. The results suggest that users' engagement with digital financial services is dictated by certain characteristics of AI-enabled systems which primarily deals with the degree of these systems' protection of users' information and transparency in making sufficient transparency. The privacy and security of AI emerged as the most influential dimension of Trustworthy AI, having a strong positive and statistically significant effect on financial inclusion. This shows that users are more likely to engage in and use digital financial services when they believe that their personal and financial information is properly protected. Given the growing dependence on digital platforms for financial transactions, effective privacy protection and cybersecurity are consequently essential to sustaining trust in the digital financial ecosystem. The research further establishes the significance of AI transparency to financial inclusion. Transparent AI can mitigate concerns regarding automated financial decision-making and allow users to better understand how technology-supported financial decisions are reached. This can enhance the trust and lead to further utilization of the digital financial services. By contrast, AI fairness positively affected financial inclusion though this result proved statistically insignificant. The discovery does not suggest that equity is irrelevant to responsible AI deployment. In the context of this research, transparency and security seem more pertinent to users' financial inclusion than their opinions regarding the fairness of algorithms involved. It is not enough to just have technology available to meaningfully include them. Services must be perceived to be safe, secure, transparent, reliable, and responsible, by both users and regulators.

7. RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made.

1. Financial institutions and FinTech suppliers must enhance the privacy and safety architecture of his or her AI-enabled digital financial services. It is important to note this recommendation because AI privacy and security have recorded the strongest significant effect on financial inclusion. Accordingly, robust data protection, secured authentication, encryption, ongoing cyber security monitoring and adequate controls against unauthorised access and misuse of customer data should be implemented by the providers.

2. Financial institutions should improve transparency of AI-driven financial services. AI transparency has a crucial influence on financial inclusion and thus users should obtain transparent and understandable information on how AI-supported processes affect users' financial services. Customers should receive clear and intelligible information in relation to automated decision-making wherever appropriate. This may include credit assessment, fraud detection, transaction monitoring, and access to products.

Transparency can reduce uncertainty and enhance the users' confidence in the digital financial platforms.

3. Governance frameworks for the responsible deployment of AI must be reinforced by regulators and financial institutions. Though the results of the study were not statistically significant, AI fairness still plays an important role in AI trustworthiness. Financial institutions should therefore periodically review AI systems for bias. Institutions should also make available a clear and accessible process to allow users to challenge or seek review of automated decisions.

Finally, financial institutions, technology companies, and stakeholders should invest in educating users. There is a need for user awareness about digital security, data privacy, AI-supported financial services and user rights. These measures will help boost confidence, encourage responsible usage, and align with the wider objective of achieving sustainable financial inclusion through trusted digital financial services in Nigeria.

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