Influence of Technology-Related Factors on The Use of Mobile Money Services in Tanzania: The Moderating Role of Financial Literacy

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Abstract

This study investigates the key factors influencing mobile money usage in Tanzania, focusing on technological determinants (mobile phone ownership, internet access, and bank account ownership), and demographic characteristics. Additionally, the study investigates the moderating role of financial literacy in shaping the relationship between these technological factors and mobile money usage. Grounded in the Technology Acceptance Model (TAM) and Theory of Planned Behaviour (TPB), the research uses a cross-sectional design with secondary data from the 2023 FSDT survey, including 9,915 individuals aged 16 and above. Two models are employed: the Diverse Mobile Money Service Usage (DMMSU), analysed using ordinary least squares (OLS), and the Likelihood of Mobile Money Service Usage (LMMSU), examined using logistic regression. Stata 14 software was used for all analyses. Study found that mobile phone ownership, internet access, and bank account ownership significantly predict mobile money usage, indicating the importance of technological access for financial inclusion. Financial literacy positively moderates the relationship between technological factors and mobile money usage, but negatively moderates the relationship between bank account ownership and mobile money usage, suggesting that financially literate individuals with bank accounts may rely less on mobile money services. This study offers a unique contribution by examining the intersection of technological determinants and financial literacy in driving mobile money usage in Tanzania. Unlike previous studies that focus solely on technology or demographics, it integrates both aspects while introducing the moderating effect of financial literacy. The research uses a nationally representative sample and applies both OLS and logistic regression models, providing comprehensive insights into diverse and likely mobile money usage behaviors.

Keywords: Mobile money, financial literacy, technological determinants.

Introduction.

In the digital transformation era, mobile money has emerged as a crucial tool for financial inclusion, particularly in developing nations, revolutionizing the financial services landscape globally (Shaikh, Glavee-Geo, Karjaluoto & Hinson, 2023). The convenience and accessibility of mobile money platforms have empowered individuals to perform essential financial activities like payments, savings, and loans through digital platforms (Adaba, Ayoung & Abbott, 2019). According to the GSMA Mobile Economy Report (2022), over 1.35 billion mobile money accounts have been registered globally, with transaction values exceeding $1 trillion annually. Sub-Saharan Africa, particularly East Africa, has been at the forefront of mobile money adoption, with countries like Kenya and Tanzania experiencing substantial growth. In Tanzania, mobile money subscriptions reached 44.35 million by March 2023, driven by increasing mobile phone penetration and enhanced mobile broadband infrastructure (Tanzania Communications Regulatory Authority [TCRA], 2023.

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While demographic factors influencing mobile money adoption have been extensively researched (Amoah & Addoah, 2020; Badran, 2017; Kiconco, Rooks & Solano, 2019), there remains a significant gap in understanding the role of technological determinants such as mobile phone ownership, internet access, and bank account ownership. These factors are critical for promoting digital financial inclusion, yet their impact on mobile money usage remains a subject of debate. For instance, while mobile phone ownership is widely recognized as a primary enabler of access to mobile money services (Aker & Cariolle, 2022), some studies argue that it is insufficient to ensure active usage without the necessary skills and financial knowledge to navigate mobile money platforms effectively (Maurer, 2012). Internet access is similarly contentious; while it enhances users' ability to engage with advanced mobile money features (Hinson, Lensink & Mueller, 2019), high data costs and connectivity issues in rural areas can limit reliance on internet-based financial services. This has resulted in a preference for USSD-based mobile money services that do not require internet access, raising questions about how internet accessibility influences adoption across different contexts.

Additionally, the ownership of bank accounts is seen as part of a broader technological ecosystem that facilitates access to digital financial services. While linking mobile money platforms to formal banking services can enhance financial management Lashitew, van Tulder, & Liasse, 2019), individuals with bank accounts may gravitate toward traditional banking due to perceived security and familiarity, potentially reducing their reliance on mobile money platforms (Diniz, Albuquerque, & Cernev, 2011). In light of the contradictions surrounding technological factors in mobile money adoption, countries like Tanzania must understand which part of the debate applies to their context to create sustainable policies. Additionally, while technological factors are crucial for mobile money adoption, financial literacy is equally important for users to effectively utilize these services. Financial literacy involves the ability to manage financial resources through skills in budgeting, saving, investing, and assessing financial risks. Research indicates that higher financial literacy enhances user engagement with financial services and fosters trust, which is essential for sustained usage (Bayar, Gavriletea & Păun, 2021).

Several studies partially highlighted the influence of individuals' financial awareness in accessing financial services. For example, financial literacy moderates the relationship between the overconfidence heuristic and investment performance (Ahmad & Shah, 2022), between financial access and the development of SMEs (Bongomin, Mpeera, Munene & Akol, 2017), between decision-making tools and equity literacy (Isidore & Arun, 2023), between account receivable management practice and the development of SMEs (Sindani, 2019) and between emotional intelligence and investment decision (Shaheen, Adnan & Qasim, 2022). However, the specific role of financial literacy in the relationship between technological-related determinants and mobile money adoption still needs to be explored. This study investigates the relationship between technological variables and mobile money usage in Tanzania, with a particular emphasis on the moderating influence of financial literacy. Drawing on the Theory of Planned Behavior and the Technology Acceptance Model, the study seeks to shed light on how technology and educational interventions might improve financial inclusion. The study is distinctive in numerous ways: it used a cross-sectional study design with data from Finscope Tanzania, providing a comprehensive view across varied demographics. It also investigates the technological elements that influence mobile money use among Tanzania's growing middle class, taking into account social, economic, and psychological viewpoints, as well as analysing both diversity and likelihood of use. Furthermore, the study contributes to bridging gaps in the scholarly literatures on financial inclusion and the role of financial innovations. The paper is organized as follows: Section two examines the theoretical and

empirical literature, Section three describes the research design, Section four explains the findings, and Section five includes a summary, conclusion, and suggestions.2.0 Review of previous studies.

Literature Review

Theoretical Review

Technology Acceptance Model (TAM)

The theory was created by Davis (1989) and expands the Theory of Reasoned Action (TRA) developed Fishbein and Ajzen (1975). TAM has been verified by researchers in multiple information systems fields (Anouze & Alamro, 2020; Lu, Yao & Yu, 2005; Yang, Wei & Fu, 2005). TAM suggests that the perceived ease of use and perceived usefulness play significant roles in determining individuals' intentions to use new technologies. It explains that the perceived simplicity of an application affects people's willingness to adopt new technology. Attitude towards adoption influences individuals' decisions about adopting new technology. When encountering new technology, various factors influence their decision on how and when to use it. Davis (1989) identified factors such as age, gender, experience, and voluntariness among individuals. In this study, factors like mobile phone ownership, bank account ownership, and internet access can be implied to impact users' perceptions of the convenience and usefulness of mobile money services.

Furthermore, TAM is suitable for our research study because mobile money technology has been promoted using the primary elements of the theory, resulting in its rapid adoption in the informal sectors of developing nations such as Tanzania. From this viewpoint, it is anticipated that residents will readily embrace and begin using mobile-based technology due to their ability to easily perceive the advantages of the new technology. Recent research has utilized the technology acceptance model to investigate human interactions with technology (Kelly & Palaniappan, 2023; Okocha & Awele Adibi, 2020). However, there needs to be more examination of how these technology-related factors impact the adoption of mobile money in Tanzania. Previous studies by Abdinoor and Mbamba (2017); Meena and Tanzania (2014) focused on the socio-economic and utility factors influencing consumer adoption of mobile financial services in Tanzania and obtained significant results. This has created a gap in academic literature regarding technology-related factors such as mobile phones, bank accounts, and internet connectivity, which this empirical research aims to address.

Theory of Planned Behavior (TPB)

Several theories have guided research studies on financial inclusion and financial literacy. One of these theories is the Financial Intermediation Theory (Allen & Santomero, 1997), which views Financial Service Providers (FSPs) as intermediaries that reduce information asymmetry and cost between surplus and deficit units. The Life-cycle Hypothesis and the Permanent Income Theory (Milton Friedman, 1957; Modigliani, 1954) emphasize the need for financial consumers to be reasonable, forward-thinking, and capable of analyzing information to make informed financial decisions and the Theory of Planned Behavior (Ajzen, 1991)which argues that individuals' desired conduct is impacted by behavioral intention as attributed to subjective norms, attitude, and perceived behavioral control. For this study, we will utilize the theory of planned behavior developed by Ajzen in 1991. This theory asserts that intentions play a crucial role in shaping behaviors, which are influenced by attitudes, subjective norms, and perceived behavioral control. The theory is based on the idea that individuals cannot fully control their behavior unless they have a positive attitude and the necessary resources, skills, and opportunities to engage in that behavior, as stated by Tucker, Jubb and Yap (2020).TPB is

essential for understanding the role of financial literacy as a moderating factor in mobile money usage. Financial literacy can impact individuals' attitudes toward digital financial services and their perceived control over using mobile money. Studies from East Africa by Mmari (2023), Mbwambo et al. (2022) and Meena and Tanzania (2014) Using this theory demonstrated a relationship between financial literacy and financial inclusion, firm performance, and financial decisions. Therefore, this study will be rooted on the theory of planned behavior, believing that financial literacy leads to a positive financial attitude and skills, influencing people's intention to use mobile money.

Empirical Review

Mobile Phone Ownership and Mobile money usage

Mobile phone ownership is a significant factor in the utilization of mobile money in Africa, as evidenced by research conducted by Suri and Jack (2016) that focused on the impact of mobile money on poverty reduction in Kenya. The widespread use of mobile phones in Tanzania provides an opportunity to utilize mobile money services to reach underserved populations. Akinyemi and Mushunje (2020) study on the factors influencing mobile money technology in rural African areas found that individuals who own mobile phones are more inclined to adopt mobile money for transactions. The study implies that owning a mobile phone improves access to information and facilitates the convenience of mobile money transactions Furthermore, the report emphasizes that mobile money services are conveyed via mobile phones, and services cannot be patronized without access to or ownership of a mobile phone. The results were supported by Bayar et al. (2021)and Douanla Meli et al. (2022) who found that mobile phone use significantly impacts financial inclusion and mobile money use in Cameroon. In contrast, Lashitew, van Tulder and Liasse (2019) using mixed methods to study mobile money adoption in Kenya, found that factors such as access to formal bank accounts and mobile phone penetration have a minimal effect on adoption rates. With this literature, we can then hypothesize that:

H_1. Mobile phone ownership drives mobile money usage.

Internet Access and Mobile Money Usage

Internet availability is critical to facilitating mobile money transfers and growing digital financial services (Bayar et al., 2021). The research on financial innovation in developing nations (Nguena, 2019) has emphasized the role of ICT infrastructure in encouraging mobile banking uptake. The study utilizes panel data and econometric techniques to investigate the determinants of mobile banking development in Africa, providing a robust analytical approach. The results showed that internet users per head positively correlate with mobile banking development in Africa. Similarly, Okocha and Awele Adibi (2020)conducted a research study on the uptake of mobile banking in Nigeria, focusing on how internet access impacts consumer habits. The study involved collecting responses from 66 Nigerian business leaders through a structured survey based on a particular model. The data was then analyzed using principal component analysis and regression analysis. The results revealed that economic worries and social impact played a critical role in the decision of business executives to embrace mobile banking in Nigeria.

Contrary to this, a study by Mothobi and Kebotsamang (2024) investigated how network coverage affects the adoption of Fintech and financial inclusion in sub-Saharan Africa. They surveyed nine African countries in 2017 and found that digital financial technologies like mobile money, mobile banking, and e-wallets, which do not rely on Internet connectivity,

significantly impacted financial inclusion in East African countries with prevalent mobile-led financial innovations. Therefore, from the kinds of literature, we can hypothesize that:
H_2. Internet availability influences the use of mobile money services.

Bank Account Ownership and Mobile Money Usage
Previous studies have emphasized the significance of bank ownership as a critical element in adopting mobile money. For instance, Myeni, Makate and Mahonye (2020) utilized data from the 2014 Fin Scope Consumer Survey for Eswatini. This survey reflects the adult population and concludes that mobile money users are 14% more likely to possess a bank account at a formal financial institution than non-users. This association is attributed to the close connection between mobile money services and banking services. In a study on the adoption and use of mobile money services in Uganda, Kiconco et al. (2019) discovered that individuals with a bank account are more inclined to adopt and utilize its various services. Similarly, Akinyemi and Mushunje (2020) applied TAM and the Two-Part Model to investigate the factors driving mobile money adoption in rural areas of Africa. They identified, years of education, age, unemployment, and ownership of bank accounts and mobile phones as the primary determinants of mobile money adoption. Furthermore, Donovan (2012)and Mushtaq and Bruneau (2019) highlight the synergies between bank ownership and mobile financial services, particularly in expanding financial access for underserved populations. These studies underscore the crucial role that existing banking services play in facilitating the transition to digital financial solutions in African nations. From the findings, we hypothesize that:

H_3. Individuals with bank accounts are more likely to adopt and use mobile money services.

Moderating Role of Financial Literacy
Financial literacy is extremely important in shaping individuals' attitudes and behaviors toward mobile money usage. Numerous studies highlight the importance of financial education in promoting responsible financial behavior and enhancing digital financial literacy (Addoah, 2021; Guyo Shibia, 2016). Financial knowledge impacts a range of economic behaviors, including having a bank account, getting insurance, understanding business finances, being interested in learning about money, planning for retirement, borrowing money, and making investments (Bilal et al., 2012; Lusardi & Mitchell, 2014; Sevim et al., 2012; Van Rooij et al., 2011). These behaviors underline the essential role of financial literacy in improving access to financial services and enhancing financial decision-making processes.

Research has shown that having a good understanding of finances is closely linked to people's ability to access both formal and informal financial services. This is particularly true for the formal financial sector, according to a study by Guyo Shibia (2016). Similarly, households with low levels of financial literacy are also less likely to engage with formal financial systems, as found in a study by van Rooij et al. (2012). These findings illustrate how financial literacy can enhance individuals' ability to navigate and engage with financial services, suggesting its potential moderating role in various financial behaviors. The influence of financial literacy on mobile money adoption and usage is significant, impacting trust, risk perception, and decision-making processes related to digital financial services. Tanpoco et al. (2022) underscored the role of financial literacy in moderating the effects of subjective norms, product involvement, and perceived behavioral control on the investment intentions of young mobile wallet app users in the Philippines. Similarly, Mutlu and Özer (2022) examined the moderating effect of financial literacy on the relationship between locus of control and financial behavior in Turkey, finding that financial literacy greatly influences individual investors' financial behavior. These findings align with those of Andarsari and Ningtyas (2019) and Lusardi and Mitchelli (2007),

who also highlight the significant moderating role of financial literacy in various financial contexts.

Given these insights, it is evident that financial literacy can moderate the relationship between technology-related factors and mobile money adoption such that Individuals with mobile phones, internet access, and bank accounts are more likely to use mobile money, given that they have received financial education. Therefore, we assert:

H_4: Financial literacy moderates (strengthen) the relationship between technology-related factors and mobile money usage.

H_{4a}: Financial literacy moderates (strengthen) the relationship between mobile phone ownership and mobile money usage.

H_{4b}: Financial literacy moderates (strengthen) the relationship between internet access and mobile money usage.

H_{4c}: Financial literacy moderates (strengthen) the relationship between bank account ownership and mobile money usage.

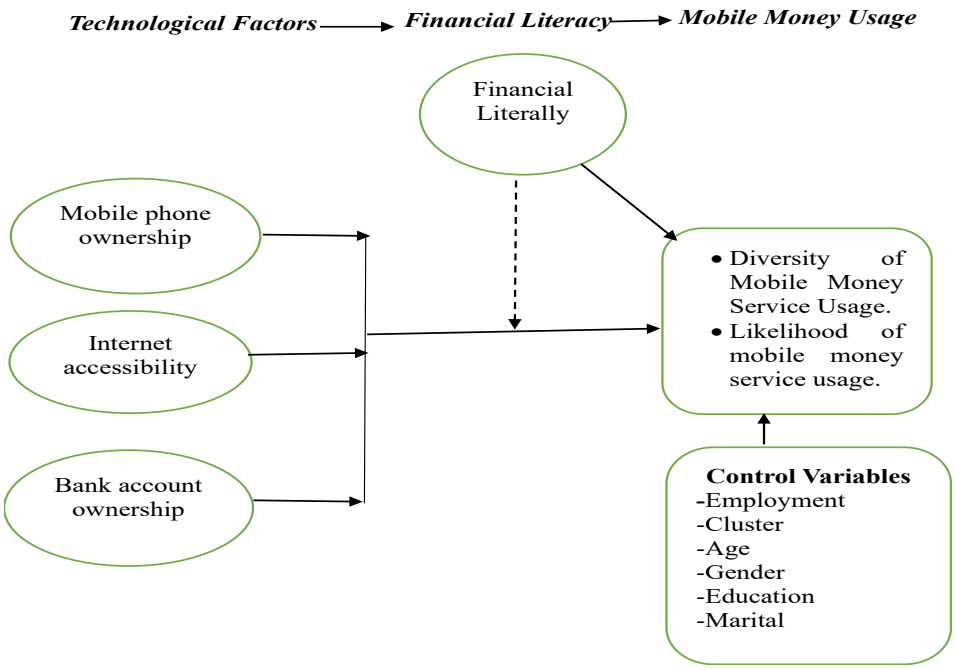

Figure 1: Conceptual framework
Source: Author's own creation.

Methodology

Research Design

This study will utilize a cross-sectional design, which involves gathering data simultaneously to analyze the relationships between variables (Saunders et al., 2020). This design was chosen primarily for its ability to elicit enormous amounts of data from samples located in dispersed places. Furthermore, unlike longitudinal designs, this approach avoids the problem of sample unavailability in follow-up investigations. Furthermore, it is free of recurring errors in study instruments because it elicits replies from selected respondents at a single point in time. Furthermore, this design may be best suited to investigations including varied measurement scales, which are effective for disrupting consistency biases and boosting validity (Rindfleisch et al., 2008).

Study Area, Study Population, and Sample Size

Area of the Study refers to the specific geographic location, context, or scope within which the research is conducted (Saunders et al., 2019). For this study, the area is Tanzania, focusing on how technology-related factors influence mobile money service usage and the moderating role of financial literacy in the process. The data is from the FSDT survey 2023 which targeted adults aged 16 and older who live in Tanzania, as they are likely to be engaged in financial activities. The goal was to collect data from 10,005 adults, but the survey successfully gathered responses from 9,915 people, achieving a very high response rate of 99.1%. The sampling technique employed by FSDT 2023 is multi-stage random sampling. This method involves several stages to guarantee a representative sample across diverse geographic and demographic segments FSDT (2023). In the first stage, Primary Sampling Units (PSUs) are selected, where geographic areas or clusters within Tanzania are chosen to represent different regions of the country. Secondary Sampling Units (SSUs) are identified within these geographic areas in the second stage. Specific communities or households are selected to provide a more focused sampling frame. Finally, in the third stage, individual respondents are randomly selected from the chosen households or communities. This multi-stage random sampling technique ensures broad representation and minimizes selection bias by systematically narrowing the sample from larger geographic units to individual participants (Creswell, 2017).

Research Variables

The dependent variable is the usage of mobile money services (MMSU). It will be captured by the diversity of mobile money services (DMMSU) and the likelihood of mobile money service usage (LMMSU). DMMSU will be measured as a natural logarithm of the row total of 11 types of mobile usages of financial services, including the purchase of goods and services, paying bills, bank transactions, borrowing, withdrawing using LIPANAMBA, saving or keeping money, putting in money when traveling to avoid carrying cash, fundraising, buying airtime or data, betting or lottery, and others (Kiconco et al., 2019). The natural logarithm will be applied to the total of these services to avoid skewness. Conversely, LMMSU will represent the respondents' likelihood of using mobile money services, which will be measured as the dummy variable that takes the value of 1 if the respondent uses mobile money services and 0 otherwise (Siddika & Sarwar, 2023).

The independent variables will be technology-related factors, such as mobile phone ownership measured as dummy variable that equals 1 if the respondent owns a mobile phone and 0 otherwise (Akinyemi & Mushunje, 2020) , access to the Internet measured as a dummy variable, which takes a value of 1 if the respondent has access to the Internet and 0 otherwise (Murendo et al., 2018). , and bank account ownership Measured on a scale of 0 to 3, where 0= No bank account, 1 = owning only one bank account, 2 = owning two or three bank accounts, and 3 = owning more than three bank accounts (Okello Candiya Bongomin & Ntayi, 2020). Financial literacy will be the moderating variable in this study measured as a dummy variable taking a value of 1 for a respondent who has ever received financial training (education) and 0 for otherwise. The control variables include age, cluster type, gender, education level, employment status, and marital status. The test for reliability and validity were conducted on the measurement scale items. The results indicated that all the items had Cronbach's Alpha coefficients above 0.7 recommended by (Nunnally, 1978). The content validity index using expert opinions and the concept validity tests were all tenable, as advised by Cohen (2008).

Data Analysis Techniques

Data analysis techniques include descriptive statistics to summarize the dataset, followed by correlation analysis to explore associations between the variables. Ordinary Least Squares (OLS) regression is applied to assess the influence of various factors on the extent of mobile money usage, while a logit regression model analyses the likelihood of mobile money usage. To ensure clear interpretation, marginal effects are estimated to determine how changes in technology-related factors affect the probability of using mobile money services. This methodology provides a robust framework for examining the impact of technology access and financial literacy on mobile money adoption in Tanzania.

Model Specification

The study employed the models represented by six equations. Equations (1) and (2) represent the OLS models used to estimate the diverse mobile money services usage (DMMSU) effects of technological-related factors (TF) and the moderating effect of financial literacy (FINEDU). Additionally, Equations (3)-(6) represent the logit models to estimate the probability of mobile money service usage (MMSU) given the TF, FINEDU, and control variables (CV). To achieve the first three objectives, the study employed Equation (1), (3), and (4) to estimate the effect of technological-related factors (TF) on mobile money services usage. Specifically, the study estimated the parameters $\theta_{j(j=1,2,3)}$, and $\gamma_{j(j=1,2,3)}$ which represent the effects of TF on DMMSU and the probability of MMSU, respectively. To address the fourth objective, the study employed Equations (2), (5), and (6) to estimate the moderating effect of financial education (FINEDU). The parameters $\lambda_{1j(j=1,2,3)}$, and $\beta_{1j(j=1,2,3)}$ were estimated to determine how FINEDU influences the relationship between TF and DMMSU, as well as the probability of MMSU.

The model specifications were as follows;

$$DMMSU_i = \theta_0 + \sum_{k=1}^{6} \theta_k CV_i + \sum_{j=1}^{3} \theta_j TF_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$DMMSU_i = \lambda_0 + \sum_{k=1}^{6} \lambda_k CV_i + \sum_{j=1}^{3} \lambda_{1j} TF_i * FINEDU_i + \sum_{j=1}^{3} \lambda_j TF_i + \lambda_2 FINEDU_i + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\Pr(MMSU = 1|TF_i, CV_i) = Pr\left(\epsilon_i > -\left(\begin{matrix}\alpha' + \sum_{j=1}^{3} \gamma_j TF_i + \\ \sum_{k=1}^{6} \gamma_k CV_i\end{matrix}\right)\right) \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$\Pr(MMSU = 1|TF_i, CV_i) = F\left(\alpha' + \sum_{j=1}^{3} \gamma_j TF_i + \sum_{k=1}^{6} \gamma_k CV_i\right) \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$\Pr(MMSU = 1|TF_i, TF_i * FINEDU_i, FINEDU_i, CV_i) = Pr\left(\epsilon_i \succ -\left(\begin{matrix}\alpha' + \sum_{j=1}^{3}\beta_j TF_i + \sum_{j=1}^{3}\beta_{1j} TF_i * FINEDU_i + \\ \beta_2 FINEDU_i + \sum_{k=1}^{6}\beta_k CV_i\end{matrix}\right)\right) \quad \epsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

$$\Pr(MMSU = 1|TF_i, TF_i * FINEDU_i, FINEDU_i, CV_i) = F\left(\begin{matrix}\alpha' + \sum_{j=1}^{3}\beta_j TF_i + \sum_{j=1}^{3}\beta_{1j} TF_i * FINEDU_i + \\ \beta_2 FINEDU_i + \sum_{k=1}^{6}\beta_k CV_i\end{matrix}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

The subscript, i, represents a household member (i=1,2,3 ……9915). The subscripts j and k represent the number of technological-related factors(j=1,2,3) and the number of control variables (k=1,2,3……6). In the logistic models represented by Equations (3)-(6), the symbol ϵ_i is a disturbance term with a mean of zero and logistically distributed with variance equal to $\pi^2/3$. The symbol Pr stands for the probability distribution function. The symbol F on the right-hand side of Equation (4) and (5) stands for the probability of the event (MMSU) to occur, which is also the logistic cumulative density function (CDF) of ϵ evaluated at given values of TF and CV.

Results and Discussion

Descriptive Statistics

The descriptive statistics provided offer insight into the factors influencing mobile money usage in Tanzania, particularly regarding technological and demographic determinants. The mean value for Diverse Mobile Money Service Usage (DMMSU) is 0.714 with a standard deviation of 0.624, indicating moderate diversity in mobile money service use. A minimum value of 0 shows that some individuals do not use mobile money services at all, while the maximum value of 2.303 reflects high engagement with a range of services. Similarly, General Mobile Money Service Usage (LMMSU) has a mean of 0.612, showing that a significant proportion of the population uses mobile money, although there is still a notable percentage that does not.

Key technological determinants like mobile phone ownership (PHONE) have a mean of 0.752, suggesting widespread ownership of mobile devices is a critical factor in mobile money adoption. However, only 28.8% of respondents have Internet access (INTERNET), which could limit the usage of more advanced mobile money features. Access to traditional financial services is also limited, with only 16.2% of respondents owning a bank account (BANK). The study also highlights low levels of financial literacy (FINEDU), with a mean of 0.15, suggesting that many respondents may lack the necessary knowledge to effectively use mobile money services. Employment, education, gender, and age were also considered, showing that most respondents were young, with lower education levels and high rates of unemployment. There is a slight majority of female respondents, and most live in rural areas. These findings suggest that while mobile money has significant reach, barriers such as limited financial education and internet access may hinder wider and more effective usage.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
DMMSU	9915	.714	.624	0	2.303
LMMSU	9915	.612	.487	0	1
PHONE	9915	.752	.432	0	1
INTERNET	9908	.288	.453	0	1
BANK	9915	.162	.435	0	3
EMPLOYMENT	9915	.128	.475	0	2
AGE	9915	3.623	.411	2.833	4.615
CLUSTER	9915	.335	.472	0	1
GENDER	9915	.557	.497	0	1
EDUCATION	9911	2.357	1.895	0	8
MARITAL	9915	.613	.487	0	1

Correlation Analysis

Correlation analysis reveals significant relationships between mobile money usage and the independent variables. There is a strong positive correlation between Diverse Mobile Money Service Usage (DMMSU) and General Mobile Money Service Usage (LMMSU) (0.843*), suggesting that those who use a variety of services are more likely to engage with mobile money overall. Mobile phone ownership (PHONE) also strongly correlates with DMMSU and LMMSU, emphasizing the importance of mobile technology in financial inclusion. Other variables, like internet access (INTERNET) and bank account ownership (BANK), show moderate positive correlations, indicating that these factors enhance mobile money usage but are less critical than mobile phone ownership. Financial literacy (FINEDU) is positively correlated with mobile money usage, highlighting the role of education in promoting the effective use of digital financial services.

Employment status, education, and age also show moderate to weak correlations, suggesting that while these factors play a role in mobile money usage, they are less significant than technological determinants. The analysis also reveals a gender disparity, with a negative correlation between gender (GENDER) and DMMSU and LMMSU, indicating that women are less likely to use mobile money services than men.

All VIF values were below the commonly accepted threshold of 5, which suggests that there is no concerning level of multicollinearity among the variables (Glantz et al., 2016).

Table 2: Correlation Analysis.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) DMMSU	1.000											
(2) LMMSU	0.843*	1.000										
(3) PHONE	0.567*	0.633*	1.000									
(4) INTERNET	0.358*	0.252*	0.218*	1.000								
(5) BANK	0.358*	0.225*	0.184*	0.282*	1.000							
(6) FINEDU	0.296*	0.212*	0.160*	0.220*	0.360*	1.000						
(7) EMPLOYMENT	0.242*	0.158*	0.137*	0.214*	0.387*	0.199*	1.000					
(8) CLUSTER	0.342*	0.250*	0.201*	0.270*	0.218*	0.183*	0.199*	1.000				
(9) AGE	0.015	0.051*	0.064*	-0.090*	0.069*	0.027*	-0.027*	-0.039*	1.000			
(10) GENDER	-0.125*	-0.090*	-0.120*	-0.046*	-0.121*	-0.058*	-0.079*	0.034*	-0.009	1.000		
(11) EDUCATION	0.402*	0.287*	0.228*	0.369*	0.400*	0.328*	0.319*	0.312*	-0.304*	-0.081*	1.000	
(12) MARITAL	0.063*	0.064*	0.105*	0.000	0.031*	0.010	-0.002	-0.076*	0.138*	-0.081*	-0.052*	1.000

**** p<0.01, ** p<0.05, * p<0.1*

Regression Results

Table 3: Linear regression results for testing dmmsu.

VARIABLES: DMMSU	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	
EMPLOYMENT	0.095***	0.086***	0.080***	0.052***	0.036***	0.073***	
	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.009)	
CLUSTER	0.216***	0.187***	0.189***	0.206***	0.158***	0.179***	
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	
AGE	0.062***	0.042***	0.065***	0.030**	0.015	0.024**	
	(0.012)	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)	
GENDER	-0.085***	-0.059***	-0.082***	-0.074***	-0.049***	-0.058***	-
	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	
EDUCATION	0.069***	0.061***	0.057***	0.055***	0.040***	0.052***	
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	
MARITAL	0.032***	0.012	0.029***	0.029***	0.008	0.011	
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	
PHONE		0.388***			0.375***	0.369***	
		(0.012)			(0.011)	(0.012)	
INTERNET			0.183***		0.143***		
			(0.011)		(0.010)		
BANK				0.180***	0.159***		
				(0.012)	(0.011)		
FINEDU						-0.059	
						(0.039)	
FINEDU*PHONE						0.241***	
						(0.041)	
FINEDU*INTERNET							
FINEDU*BANK							
Constant	-0.611***	-0.612***	-0.589***	-0.465***	-0.466***	-0.520***	-
	(0.045)	(0.043)	(0.044)	(0.045)	(0.043)	(0.043)	
Observations	9,911	9,911	9,904	9,911	9,904	9,911	
R-squared	0.499	0.550	0.514	0.511	0.569	0.558	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Logistic regression results for testing LMMSU.

LMMSU	Coef.	Robust St. Err.	t-value	p-value	[95% Conf	Marginal dy/dx	Sig
PHONE	3.515	.089	39.46	0	3.341	0.693	***
INTERNET	.409	.073	5.57	0	.265	0.093	***
BANK	.547	.121	4.49	0	.308	0.128	***
FINEDU*PHONE	-.176	.276	-0.64	.524	-.716	-0.042	
FINEDU*INTERNET	.368	.209	1.67	.095	-.064	0.082	*
FINEDU*BANK	-.397	.219	-1.84	.066	-.822	-0.093	*
FINEDU	.795	.261	3.09	.002	.291	0.169	***
EMPLOYMENT	.139	.083	1.63	.102	-.028	0.032	
CLUSTER	.558	.065	8.48	0	.429	0.131	***
AGE	.478	.078	6.25	0	.328	0.112	***
GENDER	-.039	.057	-0.68	.494	-.15	-0.009	
EDUCATION	.233	.022	11.10	0	.191	0.054	***
MARITAL	.054	.058	0.92	.358	-.061	0.013	
Constant	-5.486	.321	-17.63	0	-6.095		***
Mean dependent var		0.612	SD dependent var			0.487	
Pseudo r-squared		0.375	Number of Obs			9904	

Chi-square	4967.017	Prob > chi2	0.000

Note(s): (*) dy/dx is for discrete change of dummy variable from 0 to 1
*** p<.01, ** p<.05, * p<.1*

Research Objective 1: To Examine the Effect of Mobile Phone Ownership on The Use of Mobile Money Services.
This objective was achieved by testing the following hypothesis:

H_1: Mobile phone ownership significantly drives mobile money usage.
Conclusion on Hypothesis (H_1) testing; *the hypothesis (H_1) was accepted*.
Conclusion on Research Objective 1: *Mobile phone ownership significantly drives mobile money service usage.*

Mobile phone ownership significantly influences both the diversity of mobile money services used (DMMSU) and the likelihood of adopting mobile money services (LMMSU). Mobile phone ownership increased the R^2 from 0.499 to 0.550 in the DMMSU model, with a β of 0.388 ($p < 0.01$), indicating that individuals who own mobile phones use 47% more types of services. In the LMMSU model, mobile phone ownership increases the likelihood of adoption by 69.3%. The findings emphasize the importance of increasing mobile phone access to enhance financial inclusion, especially in underserved areas.

Research Objective 2: To Examine the Effect of Internet Accessibility on The Use of Mobile Money Services.
This objective was achieved by testing the following hypothesis:

H_2: Internet availability significantly influences the use of mobile money services.
Conclusion on Hypothesis (H_2) testing; *the hypothesis (H_2) was accepted.*
Conclusion on Research Objective 2: Internet connectivity enhances mobile money usage, particularly for more diverse services.

Internet access positively impacts both the diversity and likelihood of mobile money usage. Adding Internet access increased the R^2 from 0.499 to 0.514 in the DMMSU model, with a β of 0.183 ($p < 0.01$), meaning users with Internet access are 20% more likely to engage with diverse mobile money services. In the LMMSU model, Internet access increases the likelihood of mobile money usage by 9.3%. Internet connectivity promotes the use of more advanced mobile money services, but offline services still remain widely used.

Research Objective 3: To Examine the Effect of Bank Account Ownership on The Use of Mobile Money Services.

This objective was achieved by testing the following hypothesis:
H_3: Individuals with bank accounts are more likely to adopt and use mobile money services.
Conclusion on Hypothesis (H_3) testing; *the hypothesis (H_3) was accepted.*

Conclusion on Research Objective 3: Individuals with bank accounts tend to use a broader range of mobile money services.

Bank account ownership positively affects both the diversity and likelihood of mobile money usage. Including bank account ownership increased the R^2 from 0.499 to 0.511 in the DMMSU

model, with a β of 0.180 ($p < 0.01$), indicating individuals with bank accounts are 19.7% more likely to use diverse services. The LMMSU model shows bank account owners are 12.8% more likely to adopt mobile money services. Although bank account ownership facilitates mobile money usage, mobile money services also effectively serve unbanked populations.

Research Objective 4: To Analyze the Moderating Role of Financial Literacy on the Technology-Related Determinants of Mobile Money Service Usage.
This objective was achieved by testing the following hypothesis:
H_4: Financial literacy moderates (strengthen) the relationship between technology-related factors and mobile money usage.
H_{4a}: Financial literacy moderates (strengthen) the relationship between mobile phone ownership and mobile money usage
H_{4b}: Financial literacy moderates (strengthen) the relationship between internet access and mobile money usage.
H_{4c}: Financial literacy moderates (strengthen) the relationship between bank account ownership and mobile money usage.

Conclusion on Hypothesis (H_4) testing; *the hypothesis (H_{4a})* was accepted, (*H_{4b})* was accepted and (*H_{4c}) was rejected.*

Conclusion on Research Objective 4
H_{4a}: Financial literacy significantly strengthen the relationship between mobile phone ownership and mobile money usage.
H_{4b}: Financial literacy significantly strengthen the relationship between internet access and mobile money usage.
H_{4c}: Financial literacy has a significant negative moderation on the relationship between bank account ownership and mobile money usage.
Financial literacy strengthens the relationship between mobile phone ownership and mobile money usage (H4a accepted), and between Internet access and mobile money usage (H4b accepted), but it weakens the relationship between bank account ownership and mobile money usage (H4c rejected). Financial literacy increases the R^2 by 0.8% for mobile phone ownership and 0.6% for Internet access in the DMMSU model, but for bank account ownership, financial literacy has a negative moderating effect.

The analysis of control variables in mobile money usage revealed that employment positively influences the diversity of services used, with employed individuals 9.97% more likely to engage with a broader range of options. Urban residents are 24% more likely to use diverse services, highlighting the need for improved infrastructure in rural areas. Age positively affects usage, particularly among older individuals, who are 11.2% more likely to engage with mobile money services. Gender disparities exist, with women 8.9% less likely to use a diverse range of services, although this does not significantly impact overall adoption. Education enhances usage, with each additional level increasing the likelihood of diverse service engagement by 7.1%. Marital status has a small positive effect on service diversity but is less significant in overall mobile money usage compared to factors like employment and education

Discussion
The results affirm that Mobile phone ownership emerged as the most significant predictor, consistent with previous studies such as the GSMA's 2022 Mobile Economy Report, which underscores mobile technology's importance for financial inclusion in emerging markets, particularly in Sub-Saharan Africa. Aker and Cariolle (2022) also found a direct correlation

between mobile phone penetration and mobile money adoption, especially in rural areas where traditional banking services are limited. Internet access, while secondary to mobile phone ownership, significantly enhances the diversity of mobile money services used, supporting findings by Zins and Weill (2016) and Hinson et al. (2019), who demonstrated that internet access facilitates greater financial inclusion by expanding the use of advanced mobile money services like savings, loans, and insurance. However, in low-income areas, where USSD-based mobile money services are prevalent, internet access has a comparatively weaker effect, as noted by Mogaji and Nguyen (2022) . Bank account ownership is another crucial factor driving mobile money usage. Studies by Klapper et al. (2015) and Myeni et al. (2020) found that individuals with bank accounts are more likely to engage with mobile money platforms, while Kiconco et al. (2019) observed a similar trend in Uganda, highlighting the synergy between formal banking and mobile financial services.

Financial literacy plays a pivotal role in enhancing the effects of technological access on mobile money usage. The study aligns with Andarsari and Ningtyas (2019), who found that individuals with higher financial literacy not only adopt mobile money services more readily but also engage in a broader range of financial activities. Lusardi and Mitchell (2014) similarly concluded that financial literacy is crucial for navigating complex financial products. The study also touches on gender disparities, where research by Suri and Jack (2016) and Buvinic and Levine (2016) indicate that women face more barriers to financial literacy, impacting their ability to use mobile money effectively. Interestingly, the study finds a negative interaction between bank account ownership and financial literacy, contrasting with Demirguc-Kunt et al. (2017), who noted a positive moderating effect of financial literacy on the use of formal financial services. This suggests that financially literate individuals may prefer traditional banking over mobile money services, viewing the latter as supplementary. This observation is supported by Lusardi and Mitchell (2014), who argue that financially literate users may navigate formal systems more easily. The study also identifies the impact of socio-demographic variables on mobile money usage. Employment status positively influences mobile money usage, as financially stable individuals are more likely to engage with financial services Klapper et al. (2015). Younger individuals tend to adopt mobile money more readily, as shown by Amoah et al. (2020). Higher education correlates with greater mobile money usage, supported by Badran (2017), who linked education to increased financial literacy. However, the study confirms that gender disparities persist in mobile money adoption, echoing findings from the World Bank (2018) on the global gender gap in financial access.

Conclusion, Recommendations and Areas for Further Research

This study examined the key factors influencing mobile money usage in Tanzania, focusing on technological determinants, financial literacy, and demographic characteristics using data from the 2023 FSDT survey. Findings revealed that mobile phone ownership, internet access, and bank account ownership significantly drive mobile money adoption, highlighting the critical role of technology in enhancing financial inclusion, especially in areas with limited traditional banking infrastructure. Financial literacy emerged as a vital moderating factor, emphasizing the need for effective financial education initiatives. Demographic factors, including age, gender, employment status, and marital status, also influenced mobile money usage, indicating the necessity for targeted interventions to address the specific barriers faced by diverse groups. The study validated TAM and TPB, confirming that perceived ease of use, accessibility, and financial literacy are crucial in adopting digital financial services.

To enhance mobile money usage, it is essential for policymakers and telecommunications companies to improve mobile network coverage and reduce the cost of devices and internet

access, especially in rural areas. Simplifying Know Your Customer (KYC) requirements and lowering bank fees can encourage more people to open bank accounts linked to mobile money services. Financial education programs should focus on budgeting and mobile money usage, targeting vulnerable populations like women and older adults. Addressing gender disparities in mobile money adoption through targeted marketing and interventions will also be crucial. While this study contributes valuable insights, future research should explore longitudinal trends in mobile money adoption and the multi-dimensional nature of financial literacy, examining how specific financial skills impact usage. Additionally, understanding socio-cultural factors that influence adoption, particularly among women and rural populations, can help create more effective policies for fostering financial inclusion.

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