Asian Journal of Economics, Business and Accounting

Volume 24, Issue 8, Page 111-131, 2024; Article no.AJEBA.120384
ISSN: 2456-639X

Exploring the Influence of Financial Literacy on Mobile Financial Service Usage: An Ordered Probit Analysis

SiQi Dong [a*]

[a] *University of International Business and Economics, China.*

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: https://doi.org/10.9734/ajeba/2024/v24i81445

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/120384

Original Research Article

Received: 25/05/2024
Accepted: 24/07/2024
Published: 31/07/2024

ABSTRACT

Mobile financial service, an emerging form of financial services that has developed alongside the internet and mobile devices, are becoming increasingly significant in the global financial market. Financial literacy is crucial for safely and effectively using these services, as it equips individuals with the necessary knowledge and skills to navigate the digital financial landscape, make informed decisions, and manage their finances responsibly. This study explores the link between financial literacy and the use of mobile financial services, aiming to promote financial inclusion and help users benefit from mobile banking technologies. The results indicate that the impact of objective financial literacy varies significantly across different types of mobile financial services. It boosts the utilization of mobile banking services, with coefficient 0.025 ($p<0.01$), while simultaneously reducing the frequency of mobile payments and transfers, with coefficients -0.041 and -0.012 respectively ($p<0.01$). The results also show that subjective financial literacy always positively relate to the use of mobile banking, mobile payments and mobile transfers, with coefficients 0.038, 0.044 and 0.03 respectively ($p<0.01$). Further, this paper investigates how financial literacy miscalibration affects

**Corresponding author: E-mail: dongsiqiemail@126.com;*

Cite as: *Dong, SiQi. 2024. "Exploring the Influence of Financial Literacy on Mobile Financial Service Usage: An Ordered Probit Analysis". Asian Journal of Economics, Business and Accounting 24 (8):111-31. https://doi.org/10.9734/ajeba/2024/v24i81445.*

the use of mobile financial services. The results show that individuals who over-evaluated their financial literacy are more likely to use mobile financial services than individuals who under-evaluated or correct-evaluated their financial literacy. The results serve as decisive evidence for policymakers to enhance consumer financial literacy, thereby improving their use of mobile financial services. Future studies could delve deeper into the underlying reasons for the differential impact of objective financial literacy on various MFS types.

Keywords: Financial literacy; mobile financial services; consumer financial behavior; ordered probit regression.

1. INTRODUCTION

As mobile devices become ubiquitous and internet development advances, more and more financial institutions and enterprises began to provide mobile financial services (MFS) [1]. Compared with traditional financial services, MFS breaks the limitation of time and space, thus greatly optimizing the user experience. One of the biggest advantages of MFS is the convenience, when people need financial services, they don't have to go to a physical financial institution, they can do the business online through their mobile devices. Therefore, MFS should be widely welcomed by users. However, the adoption and use of MFS have failed to meet the expected target [2,3,4,5].

A notable discrepancy exists between the rapid pace of technological progress and the rate of mobile banking penetration [6]. Chung and Liang [7] also described the situation of mobile payments' adoption in Taiwan, “Only a quarter of consumers have any experience with mobile payments, while most of them used to adopt traditional banking services.” Scholars have studied the phenomenon of MFS not being accepted by consumers. One part of the research focuses on the product itself, suggesting that the design of MFS influence consumers' attitude and use, such as small screen size [8], systems quality and information quality [9], while the other part focuses on the consumers, arguing that their own characteristics prevent them from fully recognizing the benefits of MFS, such as self-determination [7], culture (Laforet & Li, 2005). The existing body of research is extensive, yet the consumer-oriented factors identified in the previous literature are often difficult to change, so that many of its findings are less actionable.

In this regard, in order to fill the gaps in the existing literature, we propose that enhancing financial literacy of consumer is the key to dealing with the problem. Financial literacy is defined as the capacity to make well-informed assessments and make efficient decisions concerning the distribution and management of financial resources [10]. The definition implies that there is a potential and beneficial relationship between financial literacy and an individual's financial behavior and choice-making processes. In fact, many researchers have proven it by conducting empirical tests. Current studies indicate that consumers with superior financial literacy are more likely to open and maintain their own accounts, and they excel at independently managing their financial affairs [11]. Shahrabani [12] suggested that financially literate people have a greater intention to control their budget without incurring debt. Wann [13] emphasized the significance of imparting financial literacy to college students, arguing that financial literacy course can motivate students cultivate sound financial habits, including regular saving and budgeting, engage in investment at earlier stage, and avoid the pitfalls of credit cards. Therefore, we regard using MFS as a beneficial financial behavior, and we expect consumers with higher literacy will use MFS frequently.

From perspective of theoretical meaning, this study integrates the concept of 'financial literacy' into the framework, providing new viewpoint to explaining the usage of MFS, thereby enriching the consumer financial behavior theory. From perspective of practical meaning, the study can contribute to achieve financial inclusion by clarifying the relationship between financial literacy and the usage of MFS. Meanwhile, during the empirical research phase, this study expands the analysis by incorporating additional dimensions of the variable, thereby enriching the comprehensiveness of the investigation. In detail, most prior studies focused on mobile banking and ignored the other types of MFS [14,15]. To address this research gap, this study introduces three types of MFS in total, including mobile banking, mobile payments, and mobile transfers. Mobile banking enables customers to perform a range of banking tasks remotely using their mobile devices, such as account balance checks, transfers and investments. It makes banking more convenient and accessible [16]. Mobile payments have been defined as “the payments for goods, services, and bills with a mobile device by taking advantage of wireless and other communication technologies” [17]. Unlike mobile banking, which primarily focuses on the process of transferring funds through the bank's accounts, mobile transfers take more unconventional channels into consideration, such as SMS services and third-party payment platforms. This study shows the differences among different categories of MFS, serving as a basis for financial institution managers and policymakers to increase the use of MFS. Moreover, differing from the previous literature, this study sets consumers' actual usage frequency as the dependent variable rather than the intention of adopting MFS, which makes the results more objective.

The paper is arranged as follows: in section 2, the paper will provide a comprehensive review of the previous research on MFS and financial literacy. Section 3 infers the hypothesis in this study based on previous literature conclusions. Section 4 illustrates the collected data and discusses the research setting and model. Section 6 investigates the theoretical and practical significance of the study, along with future research avenues, based on the analysis results presented in Section 5.

2. LITERATURE REVIEW

2.1 Previous Research on MFS

Most MFS research focuses on the factors that influence customer usage intentions and adoption. As early as 2007, Mallat proposed that the adoption of mobile payments is determined by specific contextual elements, such as the lack of other payment options and immediate need. Also, Mallat highlighted that the acceptance of mobile payments faces obstacles, especially the exorbitant costs, the complicated procedures, and the potential risks. Subsequently, scholars began to employ consumer behavior models in their research. The most widely used is Technology Acceptance Model (TAM), which established by Davis [18]. According to the TAM, the perceived usefulness and ease of use are the key drivers for people to accept technology and further influence their actual behavior. In the scenario of using mobile financial services, scholars further extended TAM by introducing the related factors [19]. For instance, Alsamydai [20] extends the TAM under the context of using mobile banking services by introducing the factors of quality and experience. Sun et al. [21] corporates perceived credibility and perceived cost into the original model to analyze the usage of mobile service. Besides that, scholars also use the other well-established models, such as the “Theory of Planned Behavior (TPB)” [22], “Unified Theory of Acceptance and Use of Technology (UTAUT)” [23,24], and “Diffusion of Innovation (DOI)” [25] to explore MFS adoption.

Recently, there is a burgeoning curiosity in examining the determinants that shape consumer adoption of MFS from personal-related factors. Some scholars set a series of constructs that capture consumers' inclusion and sensitivity when facing new and changeable things. Current studies have found that factors like personal habit [26], willingness and trust to new technologies [27,28,29], a tendency towards optimism [30] are positively correlated to the adoption of MFS. Meanwhile, other researchers focused on variables related to an individual's innovative capacity and technical skills, which can enhance their confidence and ability to use MFS, such as digital literacy [31], mobile phone skills’ possession [4], financial capability [32]. Meanwhile, a few studies investigated the determinants of continuance intention (CI) to use MFS, which focused on the consumers’ behavior at the post-consumption phase [33,34]. In existing literature, Expectation Confirmation Model (ECM), which proposed by Oliver in 1980, is the foundation of a post-consumption model used to explain continuous intention of MFS [35,36,34]. According to ECM, confirmation from the use of technology influences perceived usefulness and satisfaction, which were strong determinants of CI. Confirmation refers to the agreement between actual and expected performance of products or services. If the product or service performs better than expected, this is known as positive confirmation, and it typically leads to consumer satisfaction and trust level. When consumers are satisfied, they are more likely to consider buying the product or service again in the future. Based on ECM, some studies also extended model by introducing other constructs, such as trust, perceived privacy and security, self-efficiency [34] and inertia [36].

2.2 Previous Research on Financial Literacy

Financial literacy refers to the capacity to make well-informed assessments and efficient choices regarding the utilization and administration of financial resources [10]. This capability is mainly demonstrated in managing or avoiding debt, creating and adhering to budgets, saving for the future, balancing bank accounts, and effectively utilizing financial products and services [37,38]. To possess such skills, an individual must have a solid grasp of how money works and its role in the economy. This understanding is crucial for navigating the complexities of personal finance and achieving financial well-being [39,40].

Based on the criteria of objectivity and subjectivity, financial literacy can be further divided into objective financial literacy (OFL) and subjective financial literacy (SFL). The former describes the actual knowledge or skills consumers have, which often measured by the correct ratio of respondents' answers in a financial literacy test. The existing measurement approaches are varied, with different emphases. For example, Lusardi and Mitchell [41] focused on testing respondents' financial foundation with a questionnaire including three basic questions about interest, inflation and risk diversification. This allows the researcher to assess individuals' financial literacy quickly and effectively. Delavande et al. [42] utilized a more comprehensive financial literacy scale that encompassed financial concepts such as portfolio diversification, underlying principles of annuities, and so on. Respondents are asked to rate the accuracy of statements on a 12-point scale. Based on these ratings, the final scores are calculated. This method provided a more holistic assessment of the participants' grasp of financial knowledge and quantified the levels of financial literacy among different respondents. Hung et al. [43] tested individuals' ability to apply their financial decisions in real-world investment scenarios. They conducted a portfolio allocation experiment with participants in their study, observing their choices to determine whether they chose strategies that minimized investment costs. This approach offers a more direct assessment of the respondents' understanding and application abilities in financial decision-making. It not only examines the financial knowledge of the participants but also tests their behavioral choices in an actual investment setting.

Researchers often rely on subjective indicators in empirical studies of economic phenomena that are difficult to quantify with objective data [44]. The advantage of subjective measurement reflects in capturing invisible elements beyond the reach of objective measuring, which is especially valuable in areas of study involving broadly defined concepts [45]. There is currently no consensus in the academic community on the definition of financial literacy, hence the measurement methods are not standardized [46]. Therefore, scholars begin to use some type of subjective measure. In general, SFL are derived from survey questions such as "What is your knowledge of financial markets?" or "How do you estimate your level of knowledge and experience about risks and potential obligations inherent to shares, bonds, funds and structured products?", which ask respondents to assess their financial knowledge or skills. Sometimes, the respondents also might be asked to rate their agreement with statements in the questionnaire, such as "I think I can manage my finances effectively" or "I have a good understanding of investing". In addition, the confidence scale is also commonly used. It mainly asks respondents to rate their level of confidence in handling various financial tasks.

Recently, there has been a growing interest in using subjective measures in related research. Many scholars realize that using objective methods alone to measure financial literacy is very one-sided, while SFL focuses more on how individuals perceive their own financial knowledge and ability to handle financial affairs. Especially for studies of the relationship between financial literacy and consumer behavior or decision-making (involving the participation of personal subjective consciousness), the distinction between these two types of financial literacy is even more important. Many current studies in this field show the two types of financial literacy are totally distinct constructs. This part of the literature will be introduced in detail in Chapter 2.3.

2.3 The Impact of Financial Literacy on Financial Behavior

The majority of studies have concluded that financial literacy exerts a significant positive influence on individuals' financial behavior and decision-making. For instance, Wann [13] investigated the impact of financial literacy course on changing students' behavior and found that teaching financial literacy to college students can improve their financial behavior. According to the study, those students began to create budgets proactively and choose financial products that align with their needs, including savings and investments. Lusardi and Mitchell

[39] investigated Americans over the age of 50 on their retirement savings plans. The study showed that their financial literacy and planning are clearly interrelated, and financial literate individuals tend to keep track of spending and budgeting so that they can accumulate high wealth when they enter retirement. Recent research has also proved financial literacy confers benefits on individuals' financial activities, such as taking less risky credit [47], managing wealth earlier [48]. However, some researchers proposed opposing viewpoints. Mutlu and Özer [49] found that individuals with an internal locus of control exhibits a deterioration in financial behavior when financial literacy is taken into account. Also, some researchers have not identified that there are any relationships between them. Fernandes et al. [50] conducted meta-analysis which revealing that financial education interventions explained only about 0.1% of the variance in the financial behaviors.

As previously mentioned, OFL and SFL capture different aspects. Therefore, it can be inferred that they also affect financial behavior in different ways. Many scholars have realized that and conducted further research on the difference between OFL and SFL. Liu and Zhang [47] proposed that the impact of SFL on risky credit behavior was greater than that of OFL. Henager and Cude [51] found the impacts of SFL and OFL are differential across various age groups and different time horizons. In the study conducted by Kim et al. [52], OFL shows substantial negative effect on delinquency, while SFL don't. Apart from that, some literature pay attention to the discrepancy between OFL and SFL in influencing financial behavior. To some extent, it is often used to represent whether a person is overconfident in their financial knowledge [52,53]. Specifically, a person who scores himself on a higher financial literacy level must believe he(she) has better knowledge or skills in financial behavior. If a person with high SFL and low OFL is thought of as overconfident, and vice versa, he(she) is considered to be lack of confident. In general, over-confidence in one's financial literacy has been linked to speculative financial actions, such as high-level risky investment [54], the unwillingness to seeking investment advice [55], mortgage delinquency [52]. In addition, some suggest that confidence in one's financial literacy might improve financial decisions or outcomes, as taking necessary action may depend on having such confidence [46,43].

In recent years, an increasing number of studies have focused on the impact of financial literacy on the use of MFS, but the conclusions have not yet reached a consensus. Some studies found that financial literacy has a significant contribution to the usage of MFS. For example, Manoharan and Shanmugam [15] found that financial literacy is positively associated with behavioral intention to use mobile banking services. Hasan et al. [14] found that individuals having financial knowledge is the key to access financial services, as it enables people to understand and use banking options confidently and safely. Junhong et al. [56] suggested that financial literacy significantly promotes the use of mobile payments. However, there are also studies that take a dialectical view of the impact of financial literacy on the use of MFS. Those studies suggest that financial literacy can overcome the usage barrier to help people use mobile banking, while more financially sophisticated individuals are more likely to be concerned about privacy so that preventing them to use MFS [57]. In addition, some studies have not found a significant relationship between financial literacy and the use of MFS [58,31].

In summary, the existing literature has provided preliminary research on financial literacy and MFS, but it has several notable limitations, primarily reflected in the following aspects:

(1) Most of the research on MFS focuses on the factors influencing consumers' usage intentions and adoption, but few studies focus on consumers' actual use of MFS. However, only when the real condition of use is set as the dependent variable do the influencing elements become more meaningful for improving the use of MFS.

(2) There is currently very little literature linking financial literacy and the use of MFS. But in fact, the existing research has largely demonstrated that financial literacy is the key factors affecting of personal financial behavior. This implies that financial literacy is closely connected to an individual's comprehension and proficiency in financial concepts, and it is also intrinsically linked to the application of this knowledge in the process of making financial decisions and executing financial actions. In essence, it suggests that being financially literate enables individuals to navigate financial matters more effectively and make informed choices that can impact their economic well-being. Therefore, it is necessary to incorporate financial literacy into the research framework that affects MFS use.

(3) There is a lack of multi-dimensional indicator construction. Most research on MFS focuses on mobile banking, but in fact, the concept of MFS includes more dimensions, for example, mobile payments and mobile transfers.

3. RESEARCH MODEL AND HYPOTHESIS

3.1 Financial Literacy and the Use of MFS

Individual financial literacy differences are primarily reflected in their cognitive skills, which ultimately lead to differences in their decision-making and behavior. OFL is about the actual understanding and capabilities of a consumer in financial matters, while SFL is about the consumer's beliefs and perceptions of their financial literacy. Both are important, but they provide different insights into a person's financial acumen. OFL provides an objective measure, whereas SFL offers a subjective perspective on financial self-efficacy [59].

Usually, individuals need to use MFS for cash transfers, investments, wealth management, deposits, and loans on their own. This differs from traditional offline financial institutions, where service workers provide face-to-face consultation and help. Although some online services provide online assistance via chatbots, they may not address all difficulties. In particular, establishing trust can be difficult for individuals due to the absence of humanized communication. In addition, what was once typically handled by financial institution service personnel—such as customer risk assessment—increasingly requires users to have a deep understanding of their risk preferences and various financial products. Only with this knowledge can they choose the best portfolio for themselves. In this context, individuals with enough financial literacy will exhibit stronger adaptability, which means that they can quickly master the use of MFS and make full use of their functions to improve their daily lives and work [11]. Consequently, their perceived ease of use, perceived usefulness, and satisfaction are also expected to increase. Meanwhile, financially literate people are more likely to realize “confirmation” in their post-adoption, which benefits from their better understanding of fintech. Confirmation is derived from the expectation-confirmation model (ECT) and refers to the agreement between the IT product’s actual and expected performance.

However, mobile financial services are intelligent and convenient services that rely on big data, cloud computing, artificial intelligence, and other technologies through virtual remote channels such as network platforms and mobile apps. It facilitates users' lives but also comes with emerging risks such as cyber security risks, fraud risks, and privacy breaches [60,61]. Therefore, risk awareness is also an important factor affecting the use of MFS. For higher OFL users, are more risk-sensitive, and their financial behavior is more prudent, which can infer that they are more likely to stop using MFS once they perceive the risk threat of mobile finance services. In addition,

Conversely, scholars have found that self-perceived financial literacy can significantly influence an individual's attitude toward risk, potentially leading to more adventurous financial behaviors [62,63,64]. In the context of using mobile financial services, high-SFL users may be more likely to try and use MFS due to their high-risk tolerance. In addition, consumers who show a high level of SFL are more confident in their ability to make financial decisions, which may lead to them being less affected by others and more open to technological innovation.

Based on the above analysis, we infer that the relationship between financial literacy and the use of MFS is as follows:

H1a. The higher the OFL of individuals, the higher the frequency of their use of MFS.
H1b. The higher the OFL of individuals, the lower the frequency of their use of MFS.
H2. The higher the SFL of individuals, the higher the frequency of their use of MFS.

3.2 Financial Literacy Miscalibration and the Use of MFS

Financial literacy miscalibration refers to the discrepancy between an individual's self-assessment of their financial knowledge or capabilities and their actual proficiency. Overconfident individuals, who often overestimate their abilities, are more inclined to embrace higher levels of risk. This propensity for risk-taking can lead to a greater acceptance and utilization of innovative financial technologies, such as MFS. Moreover, mobile financial services offer a broader array of investment channels and products, which can be particularly appealing to overconfident investors with a higher appetite for risk assets. These investors are drawn to the novelty and potential rewards associated with a wider range of financial options. In addition, overconfident investors typically engage in frequent trading activities. MFS provides an easily accessible and convenient means for making investment decisions and executing trades. As a result, overconfident individuals may particularly appreciate and benefit from the convenience offered by MFS. However, overconfident individuals often experience losses due to extreme behavior and tend to attribute failure to external factors rather than their own decisions. In this scenario, users with excessive confidence may mistakenly perceive MFS as the cause of failure, leading them to discontinue their use of mobile finance services.

In contrast, people who lack self-confidence are constrained by their mistrust and face many obstacles in accepting financial innovation. For example, they may be more risk-averse and hesitant to adopt new financial products and services. They may also be concerned about new technology, fearing their inability to understand and master the operations of MFS. Furthermore, they may be overly worried about the security of MFS, such as personal information leaks or financial theft. As a result, such individuals exhibit extraordinary prudence when using MFS.

Based on the above analysis, we infer that the relationship between financial literacy miscalibration and the use of MFS is as follows:

H3a. Overconfidence is positively related to the frequency of individuals using MFS.
H3b. Overconfidence is negatively related to the frequency of individuals using MFS.
H4. Lack of confidence is negatively related to the frequency of individuals using MFS.

4. METHODOLOGY

4.1 Data

The dataset is derived from the State-by-State Survey of National Financial Capability Study (NFCS). The survey was founded by the FIRNA and has been conducted every three years since 2009. The survey is designed with a focus on assessing participants' financial capacity, literacy, and habits, while also providing a deeper analysis of the demographic, behavioral, and attitudinal factors that are foundational to these financial aspects. Utilizing data from the 2021 NFCS, our study is grounded in a sample that is reflective of the nation, encompassing 27,118 U.S. adults. This sampling strategy ensures a representation of approximately 500 individuals per state, extending to the District of Columbia as well. Post-exclusion of cases with absent data for certain variables, the refined dataset comprises 26,482 complete observations, forming the basis for our analytical insights.

4.2 Model Specification and Variables

This research primarily explores the effect of various factors on the use of MFS ($mobile_{fin_{h,i}}$), where i indexes individuals and h indexes the categories of MFS. It indicates the frequency of the consumer use particular mobile financial service. The model is specified as follows:

$$mobile_{fin_{h,i}} = \alpha_0 + \sum_{j=1}^{N} \beta_j * fin_{lit_{j,i}} + \sum_{k=1}^{M} \beta_k * cv_{k,i} + \gamma_s + \varepsilon_i \quad (1)$$

Here, $fin_{lit_{j,i}}$ is the independent variable in this study. It represents the financial literacy for the *i*-th individual, where j indexes the different measurements of financial literacy and N is the total number of measurements. For instance, financial literacy-related variables incorporate OFL (6 questions test respondents' financial knowledge, including compound interest, inflation, bond prices, compound interest doubling, repayment interest, and risk diversification) and SFL (people's subjective assessment of their financial literacy). In addition, whether the consumer can assess their financial literacy correctly (the gap between OFL scoring and subjective scoring) is introduced as well. The coefficients βj capture the effect of financial literacy on the use of MFS, representing the pivotal parameters in this study.

Meanwhile, there are also other factors taken into account in this study. All of them are put into the control variables, represented as cv_k. In this study, control variables include age, gender(two categories: Female vs. Male), education(three categories: High school or lower, Bachelor, Master or higher), marital status (two categories: Married and Not Married), math capability(1—Pretty good at math, 7—Not good at math), ethnicity(two categories: White and Black), the number of children (four categories: 1, 2, 3, 4 or more), risk attitude(1—Completely unwilling to take risk, 10—Extremely willing to take risk), own credit assessment(1—Extremely poor, 5—Excellent), income(1—less than $15,000, 10—$300,000 or more), work state(three categories: Not working, Self-employed, Working), whether taking part in financial markets, wealth management behavior(there are a total of 6 questions that test respondent's ability of wealth management, including income and expenditure status, debt repayment status, income stability, and savings status). Besides that, γ_s represents state-specific fixed effects, and ε_i is the error term.

Table1. Variable specification

Variable label	Attribute
Use of mobile bank	"How often do you access your checking or savings account by using mobile bank" 1—Never, 2—Sometimes, 3—Frequently
Use of mobile payments	"How often do you use your mobile phone to pay for a product or service in person" 1—Never, 2—Sometimes, 3—Frequently
Use of mobile transfers	"How often do you use your mobile phone to transfer money to another person?" 1—Never, 2—Sometimes, 3—Frequently
Financial knowledge score	Correct answers are worth 1 point, and wrong answers are not scored. 0—All answers are wrong, 6—Answered all questions correctly
Subjective assessment of financial literacy	"How would you assess your overall financial knowledge?" 1—Very low, 7—Very high
Over confidence	"Financial knowledge score is less than or equal to the average, but subjective assessment is greater than or equal to the average?" 1—Yes, 0—No
Lack of confidence	"Financial knowledge score is above average, but subjective assessment is below average?" 1—Yes, 0—No
Correct understanding	"Financial knowledge scores and subjective assessments are both greater or less than average?" 1—Yes, 0—No
Age	Age 18 to 24: Age_1 = 1, Age 25 to 34: Age_2 = 1, Age 35 to 44: Age_3 = 1, Age 45 to 54: Age_4 = 1, Age 55 to 64: Age_5 = 1, Age 65 or older: Age_6 = 1
Gender	1 = M ale, 0 = Female
High school or lower	1 = Yes, 0 = No
Bachelor	1 = Yes, 0 = No
Master or higher	1 = Yes, 0 = No
Being married	1 = married, 0 = not married
Math capability	"I am pretty good at math" 1—Total Disagreement e, 7—Total Agreement
Ethnicity	White: ethn = 1, Black: ethn1 = 0
The number of children	1 = One child, 2 = Two children, 3 = Three children, 4 = Four or more children
Risk attitude	"When thinking of your financial investments, how willing are you to take risks?" 1—Completely unwilling, 10—Extremely willing
Own credit assessment	"How would you rate your current credit record?" 1—Extremely Poor 5—Excellent
Annual Income	1 = Less than $15000, 2 = $15000 to $25000, 3 = $25000 to $50000, 4 = $50000 to $75000, 5 = $75000 to $100000, 6 = $100000 to $150000, 7 = $150000 to $200000, 8 = $200000 to $300000
Working state	1 = Not working, 2 = Self-employed, 3 = Working
whether taking part in financial markets	"Not including retirement accounts, do you have any investments in stocks, bonds, mutual funds, or other securities?" 1—Yes, 2—No
wealth management behavior	The option that shows strong management ability is worth 1 point, otherwise it is worth 0 points. 0—Not good at managing wealth, 6—Very good at managing wealth).

4.3 Estimation Method

Based on the survey data, the dependent variable ($mobile_{fin}$) is a categorical variable with a specified order (1—Never, 2—Sometimes, 3—Frequently). In such cases, the traditional OLS method will have problems with its robustness and accuracy in parameter estimation. Therefore, we employ the Ordinary Least Squares (OLS) regression method and subsequently apply the ordered probit regression to enhance the accuracy of our estimation results. Let $mobile\_fin^* = X'\beta + \varepsilon_i$. $mobile\_fin^*$ is the underlying latent variable that indexes the usage frequency of particular MFS, $X_i' \in (fin_{lit}, cv)$ and ε_i is the residual term which is assumed to be normally distributed. Meanwhile, assume that the use of MFS ($mobile\_fin^*$) follow the following rules,

$$mobile\_fin_i = \begin{cases} 1, \ if \ \ mobile\_fin_i^* \leq \delta_1 \\ 2, \ if \ \ \delta_1 \leq mobile\_fin_i^* \leq \delta_2 \\ 3, \ if \ \ mobile\_fin_i^* > \delta_2 \end{cases} \quad (2)$$

In Eq. (2), δ_1 and δ_2 are unobservable thresholds, which define the ranges of the latent variable $mobile\_fin^*$. In other words, given the ordered usage frequency of the particular mobile financial service, the respondents are forced to choose the category of $mobile\_fin_i$ that most closely represents their frequency of using MFS, $mobile\_fin_i^*$. According to Equation (2), we believe that the set of financial literacy variables and control variables in vector X can explain the MFS using frequency of respondents. Under the assumption of normality, the probabilities of the observed frequency of using MFS follow the following rules:

$$Pr(mobile\_fin_i = 1|X) = \Pr(mobile\_fin_i^* \leq \delta_1|X) = \Pr(\beta X_i' + \varepsilon_i \leq \delta_1|X) = \Pr(\varepsilon_i \leq \delta_1 - X_i'\beta) = \Phi(\delta_1 - X_i'\beta) \quad (3)$$

$$Pr(mobile\_fin_i = 2|X) = \Pr(\delta_1 \leq mobile\_fin_i^* \leq \delta_2|X) = \Pr(\delta_1 \leq \beta X_i' + \varepsilon_i \leq \delta_2|X) = \Pr(\varepsilon_i \leq \delta_2 - X_i'\beta) - Pr(\varepsilon_i \leq \delta_1 - X_i'\beta) = \Phi(\delta_2 - X_i'\beta) - \Phi(\delta_1 - X_i'\beta) \quad (4)$$

$$Pr(mobile\_fin_i = 3|X) = \Pr\left(mobile\_fin_i^* > \delta_2 \middle| X \right) = \Pr\left(\beta X_i' + \varepsilon_i > \delta_2 \middle| X \right) = 1 - \Pr(\varepsilon_i \delta_2 - X_i'\beta) = 1 - \Phi(\delta_2 - X_i'\beta) \quad (5)$$

where Φ is a normal distribution cumulative function. The structure of Eq. (3) - Eq. (5) provide the framework for our research. Estimation of parameters β, δ_1 and δ_2 is based on maximum likelihood estimation.

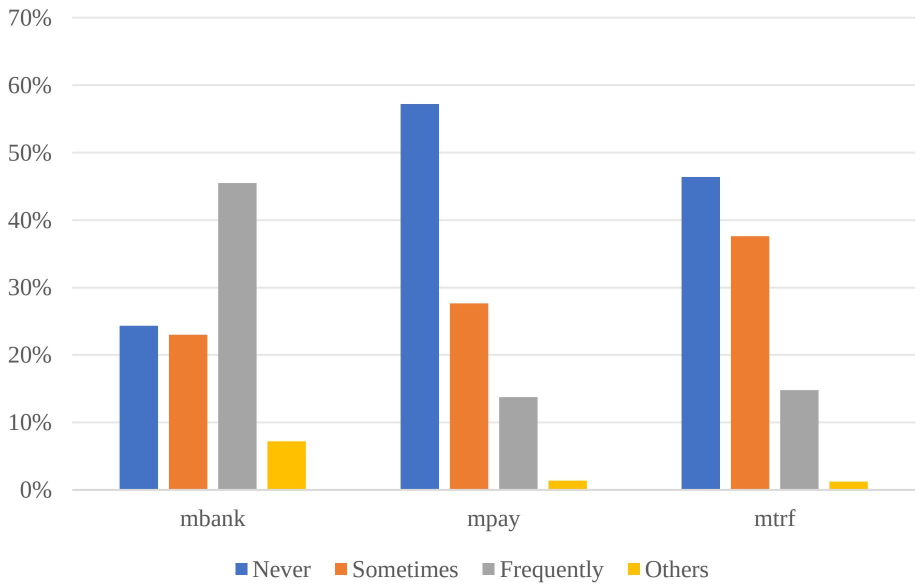

Fig. 1. The use of the three MFS in daily life by three frequency categories [1] in U.S., in %(n = 26482). Source: Summary responses from the 2021 NFCS

[1] *Others means don't know or prefer not to say.*

Table 2. Descriptive Statistics

Variable label	Variable	Obs	Mean	Std. Dev.	Min	Max
Use of mobile banking	mbank	26,482	2.067	0.991	0	3
Use of mobile payments	mpay	26,482	1.538	0.742	0	3
Use of mobile transfers	mtrf	26,482	1.659	0.739	0	3
Objective financial literacy	OFL	26,482	3.004	1.697	0	6
Subjective financial literacy	SFL	26,482	4.986	1.491	0	7
Over-Confidence	ovflit	26,482	0.367	0.482	0	1
Lack of confidence	unflit	26,482	0.07	0.255	0	1
Correct understanding	deflit	26,482	0.563	0.496	0	1
Gender	gender	26,482	0.461	0.499	0	1
Age 18 to 24	age_1	26,482	0.107	0.309	0	1
Age 25 to 34	age_2	26,482	0.173	0.378	0	1
Age 35 to 44	age_3	26,482	0.169	0.374	0	1
Age 45 to 54	age_4	26,482	0.171	0.376	0	1
Age 55 to 64	age_5	26,482	0.176	0.381	0	1
Age 65 or older	age_6	26,482	0.205	0.404	0	1
High school or lower	edu1	26,482	0.270	0.444	0	1
Master or higher	edu2	26,482	0.619	0.486	0	1
Undergraduate	edu3	26,482	0.111	0.314	0	1
Being married	married	26,482	0.494	0.500	0	1
Math capability	mathcap	26,482	5.379	1.717	0	7
Ethnicity	ethn	26,482	0.742	0.438	0	1
The number of children	child	26,482	0.646	1.045	0	4
Risk attitude	riskatt	26,482	4.961	2.773	0	10
Own credit assessment	asscrdt	26,482	3.706	1.462	0	5
Annual Income	income	26,482	4.506	2.200	1	10
Working state	worksta	26,482	2.029	0.959	1	3
Whether taking part in financial markets	finpart	26,482	0.362	0.481	0	1
Wealth management behavior	desfb	26,482	3.201	1.408	0	6

Source: The results of descriptive statistics are from the 2021 National Financial Capability Study

4.4 Statistical Description

The uses of each MFS type are displayed in Fig. 1. Regarding mobile banking, only 24.3% of respondents haven't used it, and among the users of mobile banking, about two-thirds of users use mobile banking frequently. For mobile payments, about 41.4% of the respondents use mobile payments sometimes or frequently, and above 50% of the respondents have never used mobile payments. Besides that, about 46.37% of respondents never use mobile transfers, while among the users of mobile transfers, above two-thirds of users use mobile payments sometimes. In comparison, mobile banking has the highest penetration rate, followed by mobile transfers, but most users do not use it frequently, while mobile payment has the lowest penetration rate.

Table 2 provides a comprehensive overview of the descriptive statistics for our dataset. For the dependent variable, the mean scores for the use of mobile banking, mobile payments, and mobile transfers are 2.067 out of 3, 1.538 out of 3, and 1.659 out of 3, respectively, indicating a considerably high frequency of MFS usage. The average value of OFL in our sampling is 3 out of 6, suggesting that the sampled respondents had a moderate level of OFL. In addition, the mean value of SFL in our sampling is 4.99 out of 7, suggesting that a large portion of respondents rate their own financial literacy skills at a moderate level.

5. RESULTS

5.1 Results of Correlation Analysis

Table 3 presents the correlation matrix, illustrating the relationship between the variables. In general, the correlations between financial literacy and the use of MFS are as expected. The results reveal a significant positive association between OFL and the use of mobile banking, with coefficient 0.014 ($p<0.05$). The use of both mobile payments and mobile transfers are negatively related to the OFL, with coefficients 0.123 and -0.115 respectively, at a significance level of 1%. Furthermore, in terms of SFL, the correlation matrix shows that it is significantly positive for the use of mobile banking, mobile payments, and mobile transfers, while the correlated coefficients are 0.06, 0.074, and 0.024 respectively, at a significance level of 1%.

Furthermore, the control variables exhibit significant correlations with MFS usage. For instance, individuals' risk attitude, employment status, and participation in financial markets are each positively related to MFS usage, with correlation coefficients all indicating statistical significance at the $p<0.001$ level. In contrast, the variable of own credit assessment shows a significant negative relationship with the use of mobile banking, mobile payments, and mobile transfers, with respective coefficients of -0.017, -0.071, and -0.132, each significant at the 1% confidence level. Besides that, some control variables demonstrate different correlations in the different type of MFS, such as math capability and wealth management behavior.

5.2 Financial Literacy and the Use of MFS

Table 4 displays the regression analysis outcomes, detailing how financial literacy influences the use of three distinct types of MFS. Columns (1) and (5) merely include the control variables in the analysis. More specifically, Column (1) displays the OLS regression results, and Column (5) shows the ordered probit regression results. Then, OFL and SFL are incorporated into the regression model. Wherein, the OLS regression results are displayed in Columns (2), (3), and (4). Columns (6), (7), and (8) represent the ordered regression results as a result. To eliminate the impacts of state heterogeneity on estimation results, state dummy variables are incorporated into each estimation. Furthermore, to enhance the precision and reliability of the regression findings, the reported standard errors within parentheses are adjusted for robustness.

The majority of the control variables exhibit statistical significance. According to the results, compared to female consumers, male consumers use mobile banking less frequently. Regarding age, the results show that both youth aged between 18 and 34 years and adults aged between 35 and 64 years are significantly more likely to use MFS compared to elders aged more than 65 years. Compared to those with secondary education, those who had a tertiary education (undergraduate, master, or higher) were significantly more likely to use MFS. Compared to individuals who are not married, married people are more likely to use mobile banking, while this difference is not significant in the use of the other two types of MFS (mobile payments and mobile transfers). For consumers' mathematical capability, the results show that those with more mathematical capability are significantly more likely to use banking, whereas its effect is not significant in the use of mobile payments and transfers. The effect of race is mainly demonstrated in the use of payments and transfers. Whites and non-Hispanics use them less compared to blacks. Besides that, risk attitude, annual income, and work stability are also significant positive relate to the use of MFS.

Columns (2) and (6) introduce financial literacy-related variables into the model, while the dependent variable remains the use of mobile banking. The results show that both objective and SFL are significantly positive for mobile bank usage frequency since the coefficients are positive. More specifically, consumers who have more financial knowledge are more likely to use mobile banking. Also, consumers who believe they have adequate financial literacy use mobile banking more frequently. Columns (3) and (7) substituted the previous dependent variable, mobile banking, with the utilization of mobile payments. In contrast to mobile banking, consumer objective and SFL have opposing influences on the utilization of mobile payments, with the former being negative and the latter positive. In other words, consumers with greater financial literacy are less likely to utilize mobile payment services. However, consumers who believe they have adequate financial literacy use mobile payments more frequently. Columns (4) and (8) substituted the previous dependent variable, mobile banking, with the utilization of mobile transfers. It comes to similar results as mobile payments. The consumer's OFL is negatively associated with mobile transfers usage. However, the SFL is significantly positive to mobile transfers usage frequency.

Table 3. Correlations between variables

Variables	Use of mobile banking	Use of mobile payments	Use of mobile transfers	OFL	SFL	Math capability	Risk attitude	Own credit assessment	Annual Income	Working state	Whether taking part in financial markets	Wealth managem-ent behavior
Use of mobile banking	1.000											
Use of mobile payments	0.286***	1.000										
Use of mobile transfers	0.431***	0.460***	1.000									
OFL	0.014**	-0.123***	-0.115***	1.000								
SFL	0.060***	0.074***	0.024***	0.286***	1.000							
Math capability	0.028***	-0.010**	-0.019***	0.335***	0.428***	1.000						
Risk attitude	0.148***	0.256***	0.241***	0.138***	0.290***	0.155***	1.000					
Own credit assessment	-0.017***	-0.071***	-0.132***	0.326***	0.336***	0.224***	0.146***	1.000				
Annual Income	0.097***	0.033***	0.033***	0.343***	0.281***	0.221***	0.253***	0.431***	1.000			
Working state	0.215***	0.191***	0.237***	0.023***	0.070***	0.042***	0.251***	0.075***	0.282***	1.000		
Whether taking part in financial markets	0.080***	0.064***	0.060***	0.315***	0.255***	0.166***	0.325***	0.299***	0.351***	0.096***	1.000	
Wealth manageme-nt behavior	0.026***	0.010***	-0.050***	0.315***	0.340***	0.237***	0.236***	0.494***	0.494***	0.209***	0.350***	1.000

Standard errors in parentheses

** $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$*

Table 4. Results of regressions of financial literacy on the use of MFS

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Variable	**Mobile banking**	**Mobile banking**	**Mobile payments**	**Mobile transfer**	**Mobile banking**	**Mobile banking**	**Mobile payments**	**Mobile transfer**
OFL		0.025***	-0.041***	-0.012***		0.034***	-0.059***	-0.016***
		(0.004)	(0.003)	(0.003)		(0.005)	(0.006)	(0.006)
SFL		0.038***	0.044***	0.030***		0.045***	0.073***	0.052***
		(0.006)	(0.004)	(0.004)		(0.007)	(0.007)	(0.007)
Male	-0.080***	-0.093***	0.041***	-0.062***	-0.102***	-0.119***	0.060***	-0.115***
	(0.015)	(0.016)	(0.010)	(0.011)	(0.019)	(0.020)	(0.018)	(0.019)
Age 18 to 24	0.609***	0.646***	0.445***	0.714***	0.653***	0.701***	0.780***	1.248***
	(0.031)	(0.031)	(0.024)	(0.022)	(0.041)	(0.041)	(0.042)	(0.046)
Age 25 to 34	0.702***	0.735***	0.417***	0.680***	0.786***	0.830***	0.744***	1.209***
	(0.027)	(0.026)	(0.021)	(0.019)	(0.036)	(0.035)	(0.035)	(0.036)
Age 35 to 44	0.615***	0.646***	0.309***	0.523***	0.669***	0.709***	0.572***	0.958***
	(0.024)	(0.025)	(0.018)	(0.017)	(0.030)	(0.030)	(0.030)	(0.033)
Age 45 to 54	0.505***	0.525***	0.197***	0.343***	0.532***	0.557***	0.400***	0.672***
	(0.022)	(0.022)	(0.015)	(0.012)	(0.027)	(0.026)	(0.027)	(0.024)
Age 55 to 64	0.241***	0.252***	0.086***	0.161***	0.233***	0.247***	0.200***	0.348***
	(0.021)	(0.021)	(0.012)	(0.012)	(0.023)	(0.022)	(0.023)	(0.025)
Undergraduate	0.126***	0.112***	-0.008	0.040***	0.150***	0.131***	-0.006	0.071***
	(0.014)	(0.014)	(0.013)	(0.012)	(0.017)	(0.017)	(0.022)	(0.021)
Master or higher	0.045**	0.027	0.019	0.033**	0.044**	0.020	0.033	0.058**
	(0.019)	(0.019)	(0.020)	(0.015)	(0.022)	(0.022)	(0.034)	(0.027)
Being married	-0.051***	-0.053***	0.018	-0.016	-0.064***	-0.066***	0.029	-0.028
	(0.015)	(0.015)	(0.012)	(0.011)	(0.018)	(0.018)	(0.020)	(0.020)
Mathematical capability	0.024***	0.009*	-0.003	0.007**	0.030***	0.012**	-0.003	0.013***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)
White and non-Hispanic	0.010	0.004	-0.091***	-0.071***	0.022	0.014	-0.143***	-0.115***
	(0.020)	(0.020)	(0.013)	(0.011)	(0.024)	(0.024)	(0.020)	(0.019)
Number of financially depended	0.018**	0.019**	0.056***	0.047***	0.019**	0.021**	0.085***	0.077***
children	(0.007)	(0.007)	(0.005)	(0.005)	(0.009)	(0.009)	(0.008)	(0.008)
Risk attitude	0.014***	0.010***	0.040***	0.030***	0.014***	0.009***	0.066***	0.052***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)
Credit record rating	0.004	-0.003	-0.017***	-0.031***	0.006	-0.003	-0.030***	-0.056***
	(0.006)	(0.006)	(0.004)	(0.004)	(0.007)	(0.007)	(0.007)	(0.008)
Annual income	0.035***	0.033***	0.004	0.022***	0.041***	0.038***	0.010*	0.038***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.006)
Work stability	0.076***	0.076***	0.041***	0.047***	0.092***	0.093***	0.068***	0.081***
	(0.008)	(0.008)	(0.006)	(0.005)	(0.010)	(0.010)	(0.010)	(0.009)
Participating in the financial markets	0.132***	0.116***	0.066***	0.101***	0.165***	0.143***	0.110***	0.176***
	(0.015)	(0.014)	(0.009)	(0.009)	(0.018)	(0.017)	(0.015)	(0.015)
Desirable financial behaviors	-0.024***	-0.031***	-0.008*	-0.037***	-0.029***	-0.037***	-0.014*	-0.064***
	(0.006)	(0.006)	(0.005)	(0.004)	(0.008)	(0.008)	(0.008)	(0.007)
Constant	1.177***	1.071***	1.161***	1.228***				
	(0.040)	(0.042)	(0.035)	(0.030)				
State fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26482	26482	26482	26482	26482	26482	26482	26482
Adjusted R^2	0.118	0.122	0.171	0.248	0.047	0.049	0.089	0.128

Standard errors in parentheses

** $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$*

Table 5. Regression results of whether consumers overestimate their financial literacy on the use of financial mobile services

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	**Mobile payments**	**Mobile transfer**	**Mobile payments**	**Mobile transfer**	**Mobile payments**	**Mobile transfer**
Over-evaluated financial literacy	0.242***	0.130***				
	(0.017)	(0.019)				
Under-evaluated financial literacy			-0.088**	-0.061**		
			(0.036)	(0.027)		
Correct-evaluated financial literacy					-0.203***	-0.105***
					(0.016)	(0.017)
Male	0.122***	-0.055***	0.103***	-0.065***	0.116***	-0.059***
	(0.018)	(0.018)	(0.017)	(0.019)	(0.017)	(0.018)
Age 18 to 24	0.904***	1.326***	0.924***	1.336***	0.905***	1.326***
	(0.043)	(0.046)	(0.044)	(0.047)	(0.043)	(0.046)
Age 25 to 34	0.852***	1.275***	0.867***	1.283***	0.854***	1.276***
	(0.035)	(0.034)	(0.035)	(0.034)	(0.035)	(0.034)
Age 35 to 44	0.657***	1.009***	0.676***	1.019***	0.658***	1.010***
	(0.031)	(0.033)	(0.031)	(0.034)	(0.032)	(0.033)
Age 45 to 54	0.456***	0.708***	0.458***	0.709***	0.452***	0.706***
	(0.027)	(0.025)	(0.027)	(0.024)	(0.027)	(0.024)
Age 55 to 64	0.223***	0.362***	0.224***	0.363***	0.218***	0.359***
	(0.023)	(0.025)	(0.023)	(0.025)	(0.023)	(0.025)
Bachelor	-0.012	0.076***	-0.028	0.068***	-0.021	0.071***
	(0.022)	(0.021)	(0.022)	(0.021)	(0.022)	(0.021)
Master or higher	0.050	0.083***	0.027	0.070***	0.038	0.076***
	(0.034)	(0.026)	(0.034)	(0.026)	(0.034)	(0.026)
Being married	0.024	-0.032	0.029	-0.030	0.026	-0.031
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Mathematical capability	0.009	0.028***	0.015***	0.031***	0.011**	0.029***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
White and non-Hispanic	-0.167***	-0.132***	-0.176***	-0.137***	-0.172***	-0.135***
	(0.021)	(0.020)	(0.022)	(0.021)	(0.022)	(0.020)
Number of children	0.096***	0.085***	0.102***	0.087***	0.098***	0.086***
	(0.009)	(0.008)	(0.009)	(0.008)	(0.009)	(0.008)
Credit record rating	-0.021***	-0.046***	-0.017**	-0.044***	-0.020***	-0.045***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)
Annual income	0.016***	0.045***	0.013***	0.043***	0.016***	0.044***
	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)
Work stability	0.076***	0.088***	0.081***	0.091***	0.077***	0.089***
	(0.010)	(0.009)	(0.010)	(0.009)	(0.010)	(0.009)
Participating in the financial markets	0.197***	0.255***	0.180***	0.246***	0.195***	0.254***
	(0.015)	(0.013)	(0.015)	(0.014)	(0.015)	(0.014)
Desirable financial behaviors	-0.003	-0.052***	-0.001	-0.051***	-0.001	-0.051***
	(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)
State fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26482	26482	26482	26482	26482	26482
Pseudo R^2	0.077	0.121	0.073	0.120	0.076	0.121

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6. Robustness Check

	(1)	(2)	(3)	(4)	(5)	(6)
	Mobile banking	**Mobile payments**	**Mobile transfer**	**Mobile banking**	**Mobile payments**	**Mobile transfer**
OFL	0.052***	-0.112***	-0.038***	0.038***	-0.063***	-0.017***
	(0.009)	(0.009)	(0.010)	(0.006)	(0.006)	(0.006)
SFL	0.078***	0.125***	0.090***	0.034***	0.078***	0.055***
	(0.012)	(0.012)	(0.011)	(0.008)	(0.008)	(0.007)
Male	-0.202***	0.116***	-0.202***	-0.115***	0.075***	-0.106***
	(0.033)	(0.031)	(0.033)	(0.021)	(0.019)	(0.021)
Age 18 to 24	1.342***	1.508***	2.356***	0.725***	0.785***	1.255***
	(0.071)	(0.074)	(0.079)	(0.042)	(0.041)	(0.049)
Age 25 to 34	1.510***	1.399***	2.215***	0.897***	0.765***	1.254***
	(0.060)	(0.061)	(0.062)	(0.036)	(0.037)	(0.036)
Age 35 to 44	1.280***	1.115***	1.768***	0.771***	0.570***	0.988***
	(0.053)	(0.053)	(0.056)	(0.031)	(0.033)	(0.037)
Age 45 to 54	1.001***	0.791***	1.265***	0.616***	0.390***	0.682***
	(0.046)	(0.048)	(0.045)	(0.025)	(0.029)	(0.026)
Age 55 to 64	0.438***	0.424***	0.693***	0.283***	0.198***	0.360***
	(0.039)	(0.045)	(0.048)	(0.022)	(0.024)	(0.027)
Some college to Bachelor's degree	0.206***	-0.013	0.129***	0.107***	-0.003	0.073***
	(0.029)	(0.038)	(0.036)	(0.019)	(0.025)	(0.019)
Post graduate degree or higher	0.023	0.067	0.112**	0.035	0.027	0.065**
	(0.037)	(0.058)	(0.047)	(0.024)	(0.036)	(0.028)
Being married	-0.110***	0.060*	-0.060*	-0.043***	0.029	-0.037*
	(0.030)	(0.035)	(0.035)	(0.016)	(0.022)	(0.020)
Mathematical capability	0.014	-0.015	0.017**	0.023***	-0.001	0.012**
	(0.009)	(0.009)	(0.009)	(0.006)	(0.006)	(0.005)
White and non-Hispanic	-0.001	-0.261***	-0.221***	0.007	-0.145***	-0.117***
	(0.042)	(0.036)	(0.035)	(0.027)	(0.022)	(0.022)
Number of financially depended children	0.048***	0.149***	0.142***	0.027***	0.088***	0.080***
	(0.015)	(0.013)	(0.013)	(0.010)	(0.008)	(0.007)
Risk attitude	0.020***	0.124***	0.099***	0.012***	0.068***	0.054***
	(0.006)	(0.006)	(0.006)	(0.004)	(0.004)	(0.003)
Credit record rating	-0.022*	-0.053***	-0.099***	-0.015**	-0.032***	-0.066***
	(0.012)	(0.013)	(0.013)	(0.007)	(0.008)	(0.008)
Annual income	0.064***	0.019**	0.073***		0.011*	0.040***
	(0.008)	(0.009)	(0.010)		(0.006)	(0.006)
Work stability	0.148***	0.124***	0.142***	0.084***	0.074***	0.079***
	(0.017)	(0.017)	(0.015)	(0.012)	(0.010)	(0.010)
Participating in the financial markets	0.197***	0.206***	0.312***	0.149***	0.102***	0.163***
	(0.029)	(0.026)	(0.026)	(0.019)	(0.016)	(0.016)
Desirable financial behaviors	-0.083***	-0.030**	-0.120***	-0.030***	-0.015*	-0.060***
	(0.013)	(0.012)	(0.013)	(0.008)	(0.009)	(0.009)
State fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26482	26482	26482	23078	23078	23078
Pseudo R^2	0.056	0.100	0.142	0.053	0.095	0.138

*Notes: ***, ** and * represent 1%, 5%, and 10% significance level, respectively, and the figures within parentheses denote robust standard errors.*

5.3 Over Confidence, Lack Confidence and the Use of MFS

Based on whether consumers overestimated their financial literacy, the sample is divided into three types: over-evaluated, under-evaluated, and correctly-evaluated. The sample is classified as over-evaluated if its objective financial knowledge score is falling short of the mean for the whole sample but its subjective self-assessment is exceeding the mean for the whole sample. Meanwhile, the sample is considered to have under-evaluated its financial literacy if its objective financial knowledge score is greater than the average score of the entire dataset but its subjective self-assessment is below the mean of the entire sample. In short, consumers who overestimate or underestimate their financial literacy lack a clear understanding of their own financial literacy. However, for correctly assessed consumers, their objective financial scores and subjective self-assessments should be generally consistent, which means that both should be higher than the mean or below the mean.

Accordingly, this study constructs three categorical variables to measure whether consumers overestimated their financial literacy. Table 5 shows the regression results of whether consumers overestimate their financial literacy on the frequency of using MFS.

The finding suggests that consumers who overestimate their financial literacy are more likely to use mobile payments than others (Coef = 0.242, $p < 0.01$) and mobile transfers (Coef = 0.13, $p < 0.01$), as both of their coefficients are significantly positive. Under-evaluated financial literacy consumers, on the other hand, their frequency of using mobile payments (Coef = -0.088, $p < 0.01$) and mobile transfers (Coef = -0.061, $p < 0.01$) significantly lower than the consumers in other categories. Meanwhile, even if consumers correctly assess their financial literacy, they also use mobile payments (Coef = -0.203, $p < 0.01$) and mobile transfers (Coef = -0.105, $p < 0.017$) at a lower frequency than the consumers in other categories.

5.4 Robustness Check

Table 6 exhibits the robustness check of the findings. This study substitutes the ordered probit regression with the ordered logit regression model. Columns (1), (2) and (3) show the outcomes of logit regression, with no constant term results being reported. Then, the study excluded observations with annual incomes falling below $15000 or exceeding $300,000 and the outcomes display in Columns (4), (5) and (6).

According to the results in Table 6, whether it is replaced by the logit model or outliers are removed, the relationship between consumers' OFL/SFL and MFS remains robust. Specifically, the higher the level of OFL, the frequency of consumers using mobile banking will significantly increase, and the frequency of using mobile payments and mobile transfers will significantly decrease. While the level of SFL increases, there is a significant rise in the frequency of consumers utilizing mobile banking, mobile payments, and mobile transfers.

6. DISCUSSIONS

In this study, the associations between consumer financial literacy and the use of MFS are examined by utilizing the National Financial Capability Study (NFCS). Financial literacy was measured by two sets of variables: SFL and OFL. In addition, this study considers three types of MFS: mobile bank, mobile payments and mobile transfer. This study introduced ‘financial literacy’ into the framework of the research so that enriching existing findings regarding the degree to which financial literacy is related to consumers’ financial behaviors. The results of this study reveal the pivotal role of financial literacy in driving consumer economic empowerment. For mobile banking, the coefficient of OFL and SFL is always positive which support H1a and H2. For mobile payments and mobile transfers, the coefficient of OFL is always negative and the coefficient of SFL is always positive, which supports H1b and H2. Thus, studies show that financial literacy plays a varying role in the adoption of different mobile financial services. Based on the findings of Onay et al. [57]，it may be further inferred that it is the greater reliance on fintech companies for mobile payments and mobile transfers that has led to concerns about risk, , which in turn decreases the use of MFS. Besides that, for mobile payments and mobile transfers, the coefficient of financial literacy miscalibration is always positive (over-evaluated samples regarded as 1), which supports H3a. In addition, the coefficient of financial literacy miscalibration is always negative (under-evaluated samples regarded as 1), which supports H4. The result suggests that confidence in one's financial literacy can improve the frequency of the usage of MFS, in line with Allgood and Walstad [46], Hung et al. [43]

confirming the benefits of overconfidence in financial decision-making and behavior.

7. CONCLUSIONS AND IMPLICATIONS

The study found that suggest that individuals who over-evaluated their financial literacy use MFS more often than individual who under-evaluated or correct-evaluated their financial literacy. These findings combine with previous research results that confidence in one's financial literacy has a positive relationship with financial decisions or outcomes [46,43]. This integrated result provides policy implications for promoting self-confidence in financial literacy to enhance MFS adoption. However, it is important to note that overconfidence can also lead to a refusal to seek outside guidance [65], so frequent use of MFS due to overconfidence may also cause consumers to overlook additional risks. This implies that there are also limits to stimulating people's use of MFS by improving consumers' financial self-confidence.

Furthermore, the research offers empirical evidence on the differences between SFL and OFL. It also highlights that the impact of financial literacy varies across the three distinct categories of MFS. Specifically, results indicate that both OFL and SFL increased the usage of mobile banking. However, for mobile payments and mobile transfers, OFL and SFL show different influences. OFL is negatively associated with the usage of mobile payments and mobile transfers while SFL increased their use. Therefore, it's necessary to recognize the importance and difference of both SFL and OFL in influencing the use of mobile financial services. Moreover, educational programs should be customized for each type of MFS to ensure precise and impactful interventions.

Based on the conclusions, there are some suggestions for stakeholders on adopting and using MFS. First, the government should develop and implement comprehensive financial education programs covering basic financial knowledge, risk awareness, and investment strategies, to improve users' financial literacy so that more and more users can understand and use MFS safely. Second, financial educators should give positive feedback to their students to stimulate and maintain their enthusiasm for learning. To achieve this. Third, given that studies have found that mobile payments and transfers are used less frequently by users with higher financial literacy, operators should enhance security with advanced encryption and rigorous user verification to win the trust of this group of users. Also, operators should offer personalized financial product suggestions and analyze user behavior to cater to individual customer needs effectively.

This study has some limitations and provides directions for future research. First, our research lacks an exploration of the underlying reasons for the differential impact of objective financial literacy on various MFS types. Future studies could delve deeper into it from the difference between the MFS types. Second, the purpose of this study is to increase mobile service usage, therefore simply viewing frequent usage of MFS as a positive financial behavior. This assumption, however, is inherently one-sided and ignores the disadvantages of frequent MFS usage (e.g., users ignoring the risks of MFS itself), which leads to the finding that overconfidence has a very strong positive correlation with increased MFS usage. Therefore, the advantages and disadvantages of MFS usage can be considered more comprehensively in subsequent studies.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

I declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during the writing or editing of manuscripts.

COMPETING INTERESTS

The author has declared that no competing interests exist.

REFERENCES

1. Chawla D, Joshi H. Consumer perspectives about mobile banking adoption in India – a cluster analysis. International Journal of Bank Marketing. 2017;35(4):616-636. Available:https://doi.org/10.1108/ijbm-03-2016-0037
2. Chaouali W, Lunardo R, Ben Yahia I, Cyr D, Triki A. Design aesthetics as drivers of value in mobile banking: Does customer happiness matter? International Journal of Bank Marketing. 2019;38(1):219-241. Available:https://doi.org/10.1108/ijbm-03-2019-0100
3. Foroughi B, Iranmanesh M, Hyun SS. Understanding the determinants of mobile

banking continuance usage intention. Journal of Enterprise Information Management. 2019;32(6):1015-1033. Available:https://doi.org/10.1108/jeim-10-2018-0237

4. Thakur R. The role of self-efficacy and customer satisfaction in driving loyalty to the mobile shopping application. International Journal of Retail and Distribution Management. 2018;46(3):283-303. Available:https://doi.org/10.1108/ijrdm-11-2016-0214
5. Thanh Khoa B. The impact of the personal data disclosure's tradeoff on the trust and attitude loyalty in mobile banking services. Journal of Promotion Management. 2020;27:1-24. Available:https://doi.org/10.1080/10496491.2020.1838028
6. Archana S, Kansal V. Mobile banking as technology adoption and challenges: A case of m-banking in India. International Journal of Scientific and Research Publications. 2012;2(2). Available:https://api.semanticscholar.org/CorpusID:14683856
7. Chung KC, Liang SWJ. Understanding factors affecting innovation resistance of mobile payments in taiwan: An integrative perspective. Mathematics. 2020;8(10). Available:https://doi.org/10.3390/math8101841
8. Lee KC, Chung N. Understanding factors affecting trust in and satisfaction with mobile banking in Korea: A modified delone and mclean's model perspective. Interacting with Computers. 2009;21(5):385-392. Available:https://doi.org/https://doi.org/10.1016/j.intcom.2009.06.004
9. Christian OO, Ngozi CB, Abude P, Vincent ANO. Mobile banking service quality and customer retention among commercial banks' customers: An empirical evidence from Southeast Nigeria. Asian Journal of Economics, Business and Accounting. 2023;23(14):45-56. Available:https://doi.org/10.9734/ajeba/2023/v23i141004
10. Noctor M, Stoney S, Stradling R. Financial literacy: A discussion of concepts and competences of financial literacy and opportunities for its introduction into young people's learning; 1992.
11. Nejad MG, Javid K. Subjective and objective financial literacy, opinion leadership, and the use of retail banking services. International Journal of Bank Marketing. 2018;36(4):784-804. Available:https://doi.org/10.1108/ijbm-07-2017-0153
12. Shahrabani S. The effect of financial literacy and emotions on intent to control personal budget: A study among israeli college students. International Journal of Economics and Finance. 2012;4(9). Available:https://doi.org/10.5539/ijef.v4n9p156
13. Wann C. The impact of teaching financial literacy to college students. Journal of Economics and Finance Education. 2016;16(2):98-109. Available:https://api.semanticscholar.org/CorpusID:157818775
14. Hasan M, Le T, Hoque A. How does financial literacy impact on inclusive finance? Financial Innovation. 2021;7(1):40. Available:https://doi.org/10.1186/s40854-021-00259-9
15. Manoharan B, Shanmugam V. Ascertaining the Mediating Effect of Financial Literacy for Accessing Mobile Banking Services to Achieve Financial Inclusion; 2020.
16. Shaikh AA, Karjaluoto H. Mobile banking adoption: A literature review. Telematics and Informatics. 2015;32(1):129-142. Available:https://doi.org/10.1016/j.tele.2014.05.003
17. Dahlberg T, Guo J, Ondrus J. A critical review of mobile payment research. Electronic Commerce Research and Applications. 2015;14(5):265-284. Available:https://doi.org/10.1016/j.elerap.2015.07.006
18. Davis FD. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly. 1989;13(3). Available:https://doi.org/10.2307/249008
19. Olaolu A. Digital banking adoption in Nigeria: The place of technology acceptance model. Asian Journal of Economics, Business and Accounting. 2022;22(7):59-72. Available:https://doi.org/10.9734/ajeba/2022/v22i730579
20. Alsamydai MJ. Adaptation of the Technology Acceptance Model (TAM) to the use of mobile banking services. International Review of Management and Business Research. 2014;3(4):2039-2051.

Available:https://www.irmbrjournal.com/papers/1421123221.pdf

21. Sun Q, Cao H, You J. Factors influencing the adoption of mobile service in China: An integration of TAM. Journal of Computers. 2010;5:799-806.
Available:https://doi.org/10.4304/jcp.5.5.799-806
22. Ajzen I. The theory of planned behavior. Organizational Behavior and Human Decision Processes. 1991;50(2):179-211.
Available:https://doi.org/10.1016/0749-5978(91)90020-t
23. Venkatesh, Morris, Davis, Davis. User acceptance of information technology: Toward a unified view. MIS Quarterly. 2003;27(3).
Available:https://doi.org/10.2307/30036540
24. Venkatesh, Thong, Xu. Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. MIS Quarterly. 2012;36(1).
Available:https://doi.org/10.2307/41410412
25. Rogers EM, Singhal A, Quinlan MM. Diffusion of Innovations. In. 2019;182-186.
Available:https://doi.org/10.4324/9780203710753-35
26. Yen YS, Wu FS. Predicting the adoption of mobile financial services: The impacts of perceived mobility and personal habit. Computers in Human Behavior. 2016;65:31-42.
Available:https://doi.org/10.1016/j.chb.2016.08.017
27. Asante KG, Baafi NKA. Influence of trust in the adoption of digital banking platforms: A case study of a public ghanaian bank. Asian Journal of Economics, Business and Accounting. 2022;22(17):10-19.
Available:https://doi.org/10.9734/ajeba/2022/v22i1730636
28. Nguyen TTN. Factors affect customers' intention to continue using mobile banking services at vietnam construction bank. Asian Journal of Economics, Business and Accounting. 2023;23(10):44-55.
Available:https://doi.org/10.9734/ajeba/2023/v23i10969
29. Pham TTT, Ho JC. The effects of product-related, personal-related factors and attractiveness of alternatives on consumer adoption of nfc-based mobile payments. Technology in Society. 2015;43:159-172.
Available:https://doi.org/10.1016/j.techsoc.2015.05.004
30. Humbani M, Wiese M. An integrated framework for the adoption and continuance intention to use mobile payment apps. International Journal of Bank Marketing. 2019;37(2):646-664.
Available:https://doi.org/10.1108/ijbm-03-2018-0072
31. Ullah S, Kiani US, Raza B, Mustafa A. Consumers' intention to adopt m-payment/m-banking: The role of their financial skills and digital literacy. Front Psychol. 2022;13:873708.
Available:https://doi.org/10.3389/fpsyg.2022.873708
32. Fisher P, Yeo J. Mobile financial technology and consumers' financial capability in the United States. Journal of Education and Social Policy. 2017;7:80-93.
Available:https://international.hunters.com/download/7c78e_mobile-financial-technology-and-consumers-financial
33. Naruetharadhol P, Ketkaew C, Hongkanchanapong N, Thaniswannasri P, Uengkusolmongkol T, Prasomthong S, Gebsombut N. Factors affecting sustainable intention to use mobile banking services. SAGE Open. 2021;11(3).
Available:https://doi.org/10.1177/21582440211029925
34. Susanto A, Chang Y, Ha Y. Determinants of continuance intention to use the smartphone banking services. Industrial Management and Data Systems. 2016;116(3):508-525.
Available:https://doi.org/10.1108/imds-05-2015-0195
35. Nguyen GD, Dao THT. Factors influencing continuance intention to use mobile banking: An extended expectation-confirmation model with moderating role of trust. Humanities and Social Sciences Communications. 2024;11(1).
Available:https://doi.org/10.1057/s41599-024-02778-z
36. Park M, Jun J, Park H. Understanding mobile payment service continuous use intention: An expectation - confirmation model and inertia. Quality Innovation Prosperity. 2017;21(3).
Available:https://doi.org/10.12776/qip.v21i3.983
37. Commonwealth Bank Foundation. Australians and Financial Literacy; 2004(a).

38. Roy Morgan Research. ANZ Survey of Adult Financial Literacy in Australia: Final Report; 2003a.
39. Lusardi A, Mitchell O. Financial literacy and planning: Implications for retirement wellbeing. Financial Literacy. 2006;42. Available:https://doi.org/10.2139/ssrn.1695146
40. Starcek S, Trunk A. The meaning and concept of financial education in the society of economic changes. Proceedings of the Management, Knowledge and Learning International Conference, Zadar; 2013.
41. Lusardi A, Mitchell O. The economic importance of financial literacy: Theory and evidence. Journal of Economic Literature. 2013;52(1). Available:https://doi.org/10.1257/jel.52.1.5
42. Delavande A, Rohwedder S, Willis R. Preparation for retirement, financial literacy and cognitive resources. Working Paper QP 2008-190. Michigan Retirement Research Center: Ann Arbor, MI, USA; 2008.
43. Hung A, Parker A, Yoong J. Defining and measuring financial literacy. RAND Corporation Publications Department, Working Papers; 2009.
44. Krueger A. Developments in the measurement of subjective well-being. Journal of Economic Perspectives. 2006;20:3-24. Available:https://doi.org/10.1257/089533006776526030
45. Jahedi S, Méndez F. On the advantages and disadvantages of subjective measures. Journal of Economic Behavior and Organization. 2014;98:97-114. Available:https://doi.org/10.1016/j.jebo.2013.12.016
46. Allgood S, Walstad W. The effects of perceived and actual financial literacy on financial behaviors. Economic Inquiry. 2015;54(1):675-697. Available:https://doi.org/10.1111/ecin.12255
47. Liu L, Zhang H. Financial literacy, self-efficacy and risky credit behavior among college students: Evidence from online consumer credit. Journal of Behavioral and Experimental Finance. 2021;32. Available:https://doi.org/10.1016/j.jbef.2021.100569
48. Fong JH, Koh BSK, Mitchell OS, Rohwedder S. Financial literacy and financial decision-making at older ages. Pacific-Basin Finance Journal. 2021;65. Available:https://doi.org/10.1016/j.pacfin.2020.101481
49. Mutlu Ü, Özer G. The moderator effect of financial literacy on the relationship between locus of control and financial behavior. Kybernetes. 2021;51(3):1114-1126. Available:https://doi.org/10.1108/k-01-2021-0062
50. Fernandes D, Lynch JG, Netemeyer RG. Financial literacy, financial education, and downstream financial behaviors. Management Science. 2014;60(8):1861-1883. Available:https://doi.org/10.1287/mnsc.2013.1849
51. Henager R, Cude BJ. Financial literacy and long- and short-term financial behavior in different age groups. Journal of Financial Counseling and Planning. 2016;27(1):3-19. Available:https://doi.org/10.1891/1052-3073.27.1.3
52. Kim KT, Lee J, Hanna SD. The effects of financial literacy overconfidence on the mortgage delinquency of us households. Journal of Consumer Affairs. 2019;54(2):517-540. Available:https://doi.org/10.1111/joca.12287
53. Robb CA, Babiarz P, Woodyard ANN, Seay MC. Bounded rationality and use of alternative financial services. Journal of Consumer Affairs. 2015;49(2):407-435. Available:https://doi.org/10.1111/joca.12071
54. Pikulina E, Renneboog L, Tobler PN. Overconfidence and investment: An experimental approach. Journal of Corporate Finance. 2017;43:175-192. Available:https://doi.org/10.1016/j.jcorpfin.2017.01.002
55. Lewis DR. The perils of overconfidence: Why many consumers fail to seek advice when they really should. Journal of Financial Services Marketing. 2018;23(2):104-111. Available:https://doi.org/10.1057/s41264-018-0048-7
56. Junhong Y, Yu W, Bihong H. Digital finance and financial literacy: Evidence from chinese households. Journal of Banking and Finance. 2023;156:107005. Available:https://doi.org/https://doi.org/10.1016/j.jbankfin.2023.107005

57. Onay C, Aydin G, Kohen S. Overcoming resistance barriers in mobile banking through financial literacy. International Journal of Mobile Communications. 2023;21(3):341-364.
Available:https://doi.org/10.1504/ijmc.2023.130043
58. Dao H, Ahmet Ş, An P. Empowering mobile money users: The role of financial literacy and trust in Vietnam. Borsa Istanbul Review. 2023;23(6):1367-1379.
Available:https://doi.org/https://doi.org/10.1016/j.bir.2023.10.009
59. Hadar L, Sood S, Fox CR. Subjective knowledge in consumer financial decisions. Journal of Marketing Research. 2013;50(3):303-316.
Available:https://doi.org/10.1509/jmr.10.0518
60. Hernández-Ortega B. The role of post-use trust in the acceptance of a technology: Drivers and consequences. Technovation. 2011;31(10-11):523-538.
Available:https://doi.org/10.1016/j.technovation.2011.07.001
61. Zhou T. Understanding users' initial trust in mobile banking: An elaboration likelihood perspective. Computers in Human Behavior. 2012;28(4):1518-1525.
Available:https://doi.org/10.1016/j.chb.2012.03.021
62. Croy G, Gerrans P, Speelman C. The role and relevance of domain knowledge, perceptions of planning importance, and risk tolerance in predicting savings intentions. Journal of Economic Psychology. 2010;31(6):860-871.
Available:https://doi.org/10.1016/j.joep.2010.06.002
63. Nguyen L, Gallery G, Newton C. The joint influence of financial risk perception and risk tolerance on individual investment decision ‐ making. Accounting and Finance. 2017;59(S1):747-771.
Available:https://doi.org/10.1111/acfi.12295
64. Nguyen LAG, Gerry and Newton, Cameron. The influence of financial risk tolerance on investment decision-making in a financial advice context. Australasian Accounting, Business and Finance Journal. 2016;10(3):3-22.
Available:https://doi.org/10.14453/aabfj.v10i3.2
65. Marc MK. Financial literacy, confidence and financial advice seeking. Journal of Economic Behavior and Organization. 2016;131:198-217.
Available:https://doi.org/https://doi.org/10.1016/j.jebo.2016.08.016

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/120384