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# Unlocking rural resilience: Exploring innovative digital saving solutions for farming households in Mali

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#### Abstract

Financial savings at the household level are vital for poverty alleviation, yet they face social, psychological and institutional obstacles. Over recent years, mobile phones have proven effective in enhancing financial inclusion. However, when individuals decide how to save, their preferences remain unclear. This study investigates the preferences of 421 Malian smallholder farmers for a hypothetical mobile savings application using a discrete choice experiment. Apart from standard savings account features such as transaction charges, interest amount and minimum deposit requirements, it assesses preferences for two innovative features designed to address deviations from rational decision-making. The first feature allows multiple users to pool their savings, utilising social dynamics and peer pressure to encourage responsible savings behaviour and enhance commitment. The second feature offers users the ability to manage their finances more effectively by dividing them into purpose-specific sub-accounts. The findings reveal a strong overall preference for saving via the application rather than keeping cash on hand. As anticipated, farmers favour lower costs and deposits and higher interest amounts. Generally, individual saving is preferred over group saving, and the option to compartmentalise is valued, albeit not statistically significantly so. However, the analysis of underlying heterogeneity reveals substantial differences in respondents' preferences for these commitment-enhancing features. These findings underscore the need for customised approaches that align with farmers' unique preferences and constraints. Such approaches can inform the development of bespoke

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mobile savings solutions for farming households, thereby boosting their resilience and financial well-being.

#### **KEYWORDS**

behavioral economics, discrete choice experiment, financial planning, household finance, Mali, saving

JEL CLASSIFICATION

D90, D140, D150, I30, Q12

# **1** | INTRODUCTION

In the area of rural development and poverty reduction, the focus is increasingly on promoting savings as a key measure to enhance welfare. Savings and prudent financial planning can bolster resilience and improve household well-being (Dinegde et al., 2022; Karlan et al., 2014; Steinert et al., 2018). Those who save are better prepared to weather adverse household shocks (Brune et al., 2015), enjoy greater food security (Dinegde et al., 2022) and can make profitable investments without resorting to loans (Dupas & Robinson, 2013a).

However, in low-income settings, a variety of social, psychological and institutional barriers impede savings accumulation. External constraints, such as the absence of a secure cash storage facility and the risk of theft, present considerable challenges. Social pressures, including the expectation to share excess money and financial demands from household members and the community (Fromell et al., 2021; Jakiela & Ozier, 2016), can undermine saving motivation. Regulatory hurdles and documentation requirements (Karlan et al., 2014) may deter individuals with limited savings and potentially insufficient documentation from opening formal accounts. High transaction costs, including account opening and maintenance fees or costs related to accessing bank branches or mobile money agents, may also obstruct savings accumulation. Moreover, savers may grapple with behavioural biases such as low self-control or a preference for immediate benefits over future, potentially larger rewards (Steinert et al., 2018). This bias, known as temptation spending, is prevalent not only among the poor in the so-called Global South but across all social environments. However, the impact of low self-control is often more severe for the poorest, who may struggle to mitigate this potentially harmful behaviour (Banerjee & Mullainathan, 2010).

In the absence of formal saving options, individuals may resort to alternative strategies such as group saving, hiding money, stockpiling grain, or investing in jewellery, building materials or livestock (Karlan et al., 2014). While these informal saving methods expose individuals to risks such as theft and may limit quick access to cash in emergencies, mobile financial services have emerged as a promising alternative. Over recent years, they have proven effective in enhancing financial inclusion among marginalised groups (Suri et al., 2021). Offering privacy, convenience, relative safety and liquidity relative to bank accounts or traditional saving groups (Sangaré & Guerin, 2015), they address several of the aforementioned saving obstacles and may enable the accumulation of larger amounts.

Our motivation stems from previous research suggesting that savings and prudent financial planning can transform the lives of poor households (Dupas & Robinson, 2013a; Karlan et al., 2014). Smallholder farmers in low-income economies, particularly vulnerable to income fluctuations and with limited formal saving options, stand to benefit. Given the scant evidence in this area and the rapid digitalisation in African countries, exploring digital solutions offers considerable potential for rural development and farmer resilience. Therefore, understanding smallholder farmers' preferences for saving instruments is vital to tailor offerings to their needs and circumstances. Drawing on the findings of investment and saving experiments (e.g., Jakiela & Ozier, 2016; Karlan & Linden, 2014), this study explores potential improvements to digital saving services. Recent research demonstrates how commitment-enhancing mechanisms can assist individuals in overcoming deviations from rational decision-making. For instance, Aggarwal et al. (2023) and Dupas and Robinson (2013b) examined the impact of earmarking savings for specific purposes and providing multiple labelled saving accounts on saving performance. Steinert et al. (2022) evaluated the effectiveness of a simple commitment tool, while Beaman et al. (2014) investigated group-saving approaches.

However, when individuals decide how to save, their perspectives and preferences are often unclear. While we anticipate price sensitivity among clients, there is limited knowledge about their preferences for potentially commitment-enhancing features and their general willingness to pay (WTP) for the option to privately and securely store surplus money on their phones. This study aimed to assess respondents' preferences for a digital saving service and explore the potential of mobile-based saving among Malian farmers. Our investigation is guided by two research questions: Do farmers prefer a mobile app over traditional cash-keeping methods? How do commitment-enhancing features influence their preferences?

To address these research questions, we employ a discrete choice experiment (DCE), a widely used method for assessing preferences for real or hypothetical services, products and policies (e.g., Sarfo et al., 2021). We analyse the data using mixed logit and latent class models. Building on evidence of commitment-enhancing saving mechanisms, we introduce two innovative attributes to the DCE. The group-saving attribute leverages peer pressure to potentially enhance self-control by allowing others to view the individual's savings account (Beaman et al., 2014). The key question is whether prospective savers value the opportunity to digitise group savings or prefer to save individually, potentially concealing their savings from others (Steinert et al., 2022). The final attribute, referred to as the compartmentalisation option, aims to improve cash management by enabling the division of the saving amount into smaller sub-amounts (Aggarwal et al., 2023).

Our study contributes to the literature in two main ways. First, to our knowledge, we are the first to investigate preferences and derive a WTP for a mobile saving application. While other studies have used DCEs to assess farmer preferences and their WTP for insurance products (Kirchner & Musshoff, 2024; Shee et al., 2021) and credits (Sarfo et al., 2021), there is limited understanding of preferences for saving products. The results from the mixed logit analysis indicate a strong preference for digital saving over keeping cash on hand. Our findings also reveal that respondents are price-sensitive, favouring lower transaction costs and deposits, along with higher interest rates.

Second, our DCE design incorporates two features to enhance users' saving performance by addressing self-control issues. Integrating insights from behavioural science and implementing them intelligently within savings services has the potential to effectively mitigate these adverse behavioural patterns. The mixed logit model findings suggest that the compartmentalisation option, despite its positive value, is not statistically significant. Moreover, the group-saving option does not seem to appeal to the average respondent. However, a more detailed exploration of preferences using a latent class model reveals that approximately one-third of respondents favour digital saving with peers, while two-thirds prefer individual saving using the application. Interestingly, the latent class model also shows that 50% of respondents have a statistically significant and positive preference for the compartmentalisation option.

The paper is structured as follows. Section 2 reviews the literature on commitment mechanisms, social dynamics and saving behaviour. Section 3 provides background information on the study region and the survey, including details on the DCE design, the econometric approach and the experiment's implementation. Section 4 presents the results and discusses them and section 5 concludes.

# **2** | LITERATURE REVIEW

Prior research indicates that commitment mechanisms, which limit a person's access to their funds, can enhance self-control and promote saving (Brune et al., 2015; Dupas & Robinson, 2013b). These mechanisms are categorised as hard or soft: Hard commitment mechanisms impose an economic penalty for non-compliance, binding the saver to a specific target such as a date, amount or saving goal (Karlan et al., 2014). For instance, the Malian mobile network operator *Orange*'s saving product, *Sini Tono*, mandates a 6-month account holding period, penalising early withdrawals by 5% (Global System for Mobile Communications Association [GSMA], 2015). Conversely, soft mechanisms primarily utilise psychological consequences, such as guilt or shame, to motivate savers (Karlan et al., 2014).

The trade-off between commitment and flexibility renders hard commitment devices less appealing and impractical (Karlan et al., 2014; Karlan & Linden, 2014). Financially constrained households facing daily uncertainties may need to liquidate funds quickly. Consequently, they may resist having their assets locked away for extended periods or tied to specific expenditures.

The literature on saving interventions is expanding, with experimental approaches being used to assess saving determinants. Steinert et al. (2022) conducted a randomised controlled trial in India to measure the impact of a soft commitment mechanism. They distributed a zip purse and a lockbox to the treatment group and only a lockbox to the control group among Indian informal settlers. The treatment group saved more, but contrary to the researchers' initial hypothesis, they used the zip purse to conceal their savings rather than as a commitment tool. In another study, Karlan and Linden (2014) examined a saving programme for Ugandan school children, comparing a soft commitment treatment with a more restrictive account. They found that the children saved more successfully with the weaker commitment treatment, while the more restrictive treatment had no effect. In Kenya, Dupas and Robinson (2013b) found that simple informal saving mechanisms could help individuals prepare for future health expenditures, with secure cash storage increasing health savings by 66%. They also found that groupbased schemes positively affected savings, and earmarking features were beneficial for those who frequently asked for financial assistance. Brune et al. (2015) conducted a study among Malawian farmers to facilitate formal saving for agricultural inputs. The treatment group was offered a bank account in their names to deposit their cash crop harvest proceeds directly, while the control group continued to receive their harvest proceeds in cash. The treatment increased savings and agricultural input usage.

Studies also explore social sharing norms and group dynamics. Riley (2022) conducted a study in Uganda, comparing the effects of cash and mobile money loan disbursements. The study found that digital disbursement had a positive effect on business and household finances, likely mitigating the pressure of social sharing expectations. In a laboratory experiment in Kenya, Jakiela and Ozier (2016) observed that participants, particularly women, adopted investment strategies that appeared disadvantageous due to the social pressure to share their endowments with relatives. These participants preferred to forgo expected returns to conceal the exact amount of their endowment. Fromell et al. (2021) further explored sharing norms in Kenya, identifying a spectrum of norms ranging from outright rejection of individual wealth accumulation to acceptance of moderate wealth creation.

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# **3** | DATA AND METHODS

Mali, with its flourishing mobile financial services market, serves as an ideal study location. As reported by the International Telecommunication Union (ITU), 3G connectivity was accessible to 10% of the population in 2015. This figure rose to 70% by 2022, demonstrating the rapid spread of mobile network technology across the country (ITU, 2022).<sup>1</sup> Our study focuses on farming households, given that a considerable portion of Mali's impoverished population depends on subsistence or smallholder farming as their primary income source (Food and Agriculture Organisation of the United Nations [FAO], 2017). Given the volatility of commodity prices, income variability and climate change, it is crucial to enhance their financial planning capabilities and overall resilience.

The study participants, all clients of the agricultural bank *Banque Nationale de Développement Agricole* (BNDA), were randomly selected from a list of the bank's microcredit borrowers. BNDA was chosen as a partner due to its focus on Mali's primary sector and its provision of short- and medium-term loans to small farmers, in addition to large corporations. This enabled us to target our desired sample of smallholder farmers. The respondents, primarily residing near Bamako and the southern regions of Koulikoro and Sikasso, mainly produce cereals and maize. Around half of the sample also cultivate vegetables, roots and tubers for subsistence or own livestock such as cattle and small ruminants. Trained local enumerators conducted face-to-face interviews and the DCE at the participants' homes between December 2022 and February 2023. The questionnaire comprised a consent form, sociodemographic questions and the DCE, which included choice cards, follow-up questions on perceived difficulty and attribute ranking.

In November 2022, we conducted a week-long intensive training in Bamako to thoroughly prepare the enumerators and minimise potential biases. The enumerators, compensated for both the data collection and the training week, were experienced in data collection and recruited by our local survey team, specifically staff from BNDA and the University of Bamako. Our partners advised us to emphasise training in both French and Bambara, as despite French being the official working language, many Malians prefer Bambara, particularly those in rural areas. During the training, enumerators practised the DCE multiple times in pairs, alternating the roles of interviewer and interviewee. They were encouraged to provide constructive feedback on the translation from French to Bambara and appropriate behaviour during the choice situation (e.g., avoiding subjective suggestions when the respondent appeared indecisive). Ultimately, most interviews were conducted in either Bambara or a combination of French and Bambara, as reported by the enumerators.

# 3.1 | Attribute and level selection

We utilise a DCE to examine Malian farmers' preferences for various attributes of a hypothetical mobile phone-based savings application. This method, part of the attribute-based methods group, is used to elicit preferences for real or hypothetical services, products or policies.<sup>2</sup> The savings application is viewed as a combination of design attributes, categorised into conditions or requirements (e.g., associated cost) and user benefits (e.g., interest payments or innovative features that could enhance savings). Farmers evaluate these conditions and benefits when

<sup>&</sup>lt;sup>1</sup>Growth in 3G network coverage, albeit slower, is evident in neighbouring West African countries such as Niger (10% in 2015 to 24% in 2021), Mauritania (30% in 2015 to 44% in 2022) and Algeria (46% in 2015 to 98% in 2022) (ITU, 2022).

<sup>&</sup>lt;sup>2</sup>Choice experiments are grounded in Lancaster's consumer choice theory and McFadden's extension of discrete choice theory (Lancaster, 1966; McFadden, 1973). These theories posit that individuals derive utility from a good's specific attributes, not the good itself.

deciding whether to use the application to save a specified 10,000 FCFA.<sup>3</sup> Their choices provide insights into their attribute preferences.

We developed attributes and their levels through a multi-stage process, including stakeholder discussions and an extensive literature review (Ryan et al., 2012). In line with Lancsar and Louviere (2008), we included all attributes potentially important for decision-making. To avoid biasing the DCE results by omitting important attributes, we included accumulated *Total transaction cost per month, monthly interest amount* and *minimum deposit*. These attributes were deemed essential as they were observed in every mobile savings instrument on the market during our literature review. Additionally, we incorporated two innovative features, group saving and compartmentalisation, aimed at mitigating behavioural constraints (Banerjee & Duflo, 2007; Dupas & Robinson, 2013a, 2013b; Karlan & Linden, 2014). The following paragraphs detail our selected attributes and their corresponding levels (Table 1).

#### 3.1.1 | Accumulated transaction cost

Typically, storing cash outside one's home incurs transaction costs, including account opening and running fees, transportation and opportunity costs when savers must travel long distances to the nearest ATM or mobile money agent (Sangaré & Guerin, 2015). Studies in Nepal (Prina, 2015) and Kenya (Dupas & Robinson, 2013a) show that clients are price-sensitive and highly responsive to changes in savings account costs. For mobile savings services, the primary cost component is usually the withdrawal cost (Orange, 2023a). Clients typically pay a percentage of the withdrawal amount each time they withdraw cash. For instance, in Mali, mobile network operator Orange (2023a) charges a fee ranging from 0.025% to 17.5%, depending on the withdrawal amount. Orange's competitor, Moov from Malitel, charges 0.9% of the withdrawal amount and 115 FCFA per transaction for transfers from the bank account to the client's Moov Money mobile account (Moov, 2023). However, clients exhibit diverse saving and withdrawal behaviours. Some deposit and withdraw cash weekly, while others may only withdraw biannually. We derived average values from the real-life data of Mali's leading mobile network operators, Orange and Malitel. These averages represent the total hypothetical monthly costs, including travel expenses to the nearest agent, withdrawal costs (assuming savers withdraw at least bi-monthly) and other account fees. To minimise cognitive load for respondents with limited numeracy skills, we followed Sarfo et al. (2021) and presented the transaction costs in absolute values. The figures of 100, 200, 400 and 800 FCFA per month approximate the recurring monthly costs associated with using a saving application for a specified amount of 10,000 FCFA.

#### 3.1.2 | Interest amount

Prina (2015) theorises that higher inflation rates reduce the appeal of saving. Steinert et al. (2018) observe that in African economies, high inflation often leads to negative real interest rates on savings. Despite the relatively low interest rates offered by Malian providers relative to typical African inflation rates, we posit that they serve a signalling and motivational function in the decision to adopt and use a saving application. For instance, *Sini Tono* offers

<sup>&</sup>lt;sup>3</sup>We determined the savings value through a literature review and expert interviews. Following Warren and Warren Tyagi (2005) recommendation that individuals should ideally save 20% of their income, we applied this to the Malian average GDP of 833 USD per annum, or 41,775 FCFA per capita per month. This equates to savings of 8355 FCFA. To validate this in a low-income economy context, we conducted further expert interviews with Malians and adjusted the reference value to 10,000 FCFA. This aligns with findings from Ghana (Aidoo-Mensah, 2019) that farmers tend to save income increments.

<b>TABLE 1</b> Overview of attributes and attribute levels used in the choice experimer
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Attribute	Levels
Accumulated transaction cost/month (in FCFA)	100, 200, 400, 800
Interest amount/month (in FCFA)	0, 25, 50, 75
Minimum deposit (in FCFA)	0, 100, 500
Group saving	Yes/no
Compartmentalisation	Yes/no

*Note*: FCFA refers to the CFA-Franc (issued by the Central Bank of the West African States [BCEAO]) and is tied to the Euro with a fixed exchange rate of 655.96 FCFA = 1  $\in$ .

an annual interest rate of 2%, with monthly instalments paid into the account (Orange, 2023b). Another operator, *Baobab*, offers a range of saving plans with annual returns between 4% and 8% (Baobab, 2023).

Notably, Mali's population is predominantly Muslim, and according to Sharia law and Islamic principles, savers should not earn interest. However, Ahmad et al. (2023) found that in Pakistan, Islamic banks pay profits instead of interest, thereby resolving this issue. In Mali, Sharia regulations are not deeply embedded in the country's legal and societal systems (Schulz, 2010). Sangaré and Guerin (2015) did not identify a conflict between Islamic banking, mobile money and interest earnings in their study on saving and mobile money in Mali. We thus do not anticipate that interest earnings will be problematic or perceived as unethical within our sample, as we are interviewing only microcredit borrowers from the BNDA, where loan interest fees and savings interest earnings are commonplace.

In line with our rationale in the TAC section, we present this attribute in absolute values to avoid overburdening the respondents. We explained it as the monthly earnings they could accrue by keeping their savings in the account. Reflecting industry figures, we kept the interest amounts relatively low. Corresponding to the aforementioned annual interest rates of 2%-8% for 10,000 FCFA (16–67 FCFA/month), we included the monthly interest amount with the levels of 0, 25, 50 and 75 FCFA.

# 3.1.3 | Minimum deposit

Mobile savings accounts often feature a minimum deposit. For instance, Sini Tono necessitates an initial deposit of 3000 FCFA, and once active, the account must maintain a balance of at least 100 FCFA (Orange, 2023b). In contrast, neither Moov (2023) nor *Baobab's SUN SUN<sup>4</sup>* savings account require a minimum deposit (Baobab, 2023). However, other Baobab savings plans, such as *Waati surun* and the *Waati Jan*,<sup>5</sup> mandate monthly deposits of 10,000 FCFA, while the Dépôt à Terme (DAT) savings plan requires a minimum balance of 50,000 FCFA (Baobab, 2023). These latter accounts are more ambitious and restrictive than our approach. In our app design, we include minimum deposit levels of 0, 100 and 500 FCFA. We aim to assess respondents' preferences for a zero deposit, a typical value (100 FCFA) that aligns with current savings plans (Orange, 2023b), and a hypothetical upper-end value (500 FCFA) we

<sup>&</sup>lt;sup>4</sup>According to *Baobab's* customer service *Sun sun* in the Bambara language refers to a fruit similar to the soursop. The account type *SUN SUN* is inspired by the proverb *San nana, san mana sun sun bè dén*, which means *With or without rain, the sun sun bears fruits*. It suggests that positive outcomes can be achieved regardless of external conditions.

<sup>&</sup>lt;sup>5</sup>*Waati surun* in Bambara translates to *the time has come* in English. *Waati* means time, and *surun* means to arrive or come. *Jan* refers to the year or season, so *Waati Jan* in Bambara can be translated to *time of the year* or *season* in English.

deem acceptable to request during the survey. This latter value corresponds to a total savings amount of 10,000 FCFA.

# 3.1.4 | Group saving option

Our DCE design incorporates two soft commitment mechanisms. The first emulates a simplified group-saving mechanism, leveraging self-established regulatory frameworks that make violations of saving intentions costly through potential damage to social reputation, feelings of failure or guilt (Soman & Cheema, 2011). Studies in Mali (Beaman et al., 2014) and Chile (Kast et al., 2012) demonstrated how peer saving can enhance saving success. The startup *MaTontine* offers a digitalised group-saving service, allowing users to manage their *Tontine*<sup>6</sup> account digitally, thereby improving their credit score and qualifying them for more favourable credit conditions (Akande & Turner, 2018; GSMA, 2023). To our knowledge, this is a novel approach to mobile money features.

To simplify, we limit the number of possible saving partners. The primary goal is to ascertain whether the respondent prefers to save alone, valuing privacy and hidden savings, or with peers, potentially benefiting from peer pressure to maintain account balance. We explained the attribute as follows: You have the option to save in a group of three trusted individuals (friends, family) towards a shared goal. Multiple registered customers can access a shared account. Every member must pay the transaction cost displayed in the respective alternative on the choice card. When one member withdraws money, all others receive a notification. Alternatively, you can use a standard individual account for personal savings, which is inaccessible to others. Both options cannot be used simultaneously.

## 3.1.5 | Compartmentalisation option

Another attribute aimed at enhancing commitment is the option to compartmentalise a large amount into smaller, more manageable units. This attribute is rooted in the concept of mental accounting (Thaler, 1985), allowing respondents to divide their savings accounts into subaccounts for specific purposes such as household expenses, education, farm investments and emergency funds. We anticipate that respondents will assign varying levels of liquidity to these sub-accounts. For instance, an account for household expenses might be accessed first, while a higher mental barrier might exist to liquidate funds in an emergency fund sub-account. Spending money from a sub-account for a purpose other than its intended use could evoke feelings of failure or guilt. Although this barrier is primarily psychological, goal orientation could inspire higher savings through improved management (Aggarwal et al., 2023). These mechanisms are referred to as partitioning, earmarking or labelling in the literature (Soman & Cheema, 2011; Steinert et al., 2018). We explain the attribute to the respondent as follows: You have the option to compartmentalise your funds within your account. You can allocate your money towards different purposes within the same account, such as business, emergencies, leisure or children's education. Alternatively, you can use a standard account where all your money is in one place.

<sup>&</sup>lt;sup>6</sup>Tontine is a traditional community-based savings practice common across the African continent. Known by various names depending on the country and local dialect, it typically involves each participant contributing a fixed sum to a common fund. Savers then take turns collecting the money until every participant has done so once (Akande & Turner, 2018).

# 3.2 | Setting up the experiment

The five attributes and their respective levels imply a full factorial design with  $320(5 \times 2^4 \times 1^3 \times 2^2)$  combinations. Each combination signifies a potential standard. Given the impracticality of presenting all combinations to respondents, we reduced the number of alternatives. We employed Ngene to select choice cards using a D-efficient, fractional factorial design, excluding interaction terms (Hensher et al., 2015). Before the software application, we excluded the combination of the highest interest amount with the lowest transaction costs and the lowest interest amount with the highest transaction costs. Consequently, 308 combinations were excluded, and Ngene computed 12 choice scenarios. An additional dominant scenario was included to identify respondents who may have misunderstood the task.

To mitigate response fatigue, the alternatives were randomly divided into two blocks, each comprising six choice cards and one dominant scenario. Respondents were randomly assigned a block and presented with seven choice cards. Each card offered three options: two savings application choices and an opt-out option (retaining money personally). Figure 1 presents an example choice card in English; the original French choice cards are available in Appendix S1.

# **3.3** | Econometric approach

Following Hauber et al. (2016) and McFadden (1973), we posit that a smallholder farmer n in our sample (n=1, ..., N) can receive utility U by selecting alternative j from a finite set of J alternatives in choice situation s. The utility is described by two components:

$$U_{nsj} = V_{nsj} + \varepsilon_{nsj} \tag{1}$$

where the vector of explanatory variables  $V_{nsj}$  is the deterministic, observable component, defined by the attribute levels for alternative *j*. The stochastic influence  $\varepsilon_{nsj}$  is the independently, identically distributed (IID) extreme value of the unobserved expected utility, also known as the error



**FIGURE 1** Example choice card. *Source*: Authors' visualisation. [Colour figure can be viewed at wileyonlinelibrary.com]

term (Train, 2009). The IID nature precludes correlation among the error components of the alternatives.  $V_{nsj}$  comprises two parts,  $X_{nsj}$  and  $\beta_n$  and is specified as follows:

$$U_{nsj} = V_{nsj} (\beta_n X_{nsj}) + \epsilon_{nsj}$$
<sup>(2)</sup>

where  $\beta_n$  denotes the vector of parameters reflecting the respondent's preferences, and  $X_{nsj}$  represents the vector of attributes of the saving application and personal characteristics. We assume that smallholder farmer *n* considers all alternatives in each choice situation and selects the one that maximises utility. While the conditional logit model, also known as the multinomial logit model, forms the basis for DCEs, its independence from irrelevant alternatives (IIA) assumption has led to alternative specifications. The mixed logit model, or random parameters logit, is a prominent alternative that allows for preference heterogeneity and addresses the restrictive and often unrealistic IIA assumption of the conditional logit model (Greene & Hensher, 2003; Train, 2009). The probability of individual smallholder farmer *n* choosing alternative *j* over any other alternative *i* is given by:

$$\operatorname{Prob}_{nsj} = \frac{\exp(V_{nsj} + \epsilon_{nsj})}{\sum_{t=1}^{J} (V_{nsi} + \epsilon_{nsi})}$$
(3)

The base specification allows us to ascertain whether a particular attribute level influences a farmer's preference for an alternative, as indicated by the sign of the respective coefficients. We specify the base model as follows:

$$U_{nsi} = \beta_0 ASC + \beta_1 TAC + \beta_2 interest + \beta_3 deposit + \beta_4 group + \beta_5 compartmentalisation + \epsilon_{nsi} (4)$$

In Equation (4), we include an alternative specific constant (ASC) to account for the presence of an opt-out option in the choice sets. ASC is a dummy variable,<sup>7</sup> coded 1 for the application adoption alternatives and 0 for the opt-out option. *TAC* represents the accumulated monthly transaction cost; *interest* refers to the monthly interest amount; and *deposit* denotes the minimum deposit required to maintain the account. *Group* and *compartmentalisation* are dummy-coded variables referring to the commitment mechanisms of group saving and the option of multiple sub-accounts, respectively. Furthermore, we specify *ASC*, *group* and *compartmentalisation* as having a random component. *TAC*, *interest amount* and *deposit* are specified as fixed, assuming homogeneous preferences among farmers for minimising costs and maximising returns. We assume all model coefficients to follow a normal distribution.

Our primary analysis utilises a mixed logit model. To investigate the factors influencing preference heterogeneity, we extend the base model through interaction terms, building on Equation (4) as done by Meemken et al. (2017). Furthermore, we estimate a latent class model, following the approach of Nordmeyer et al. (2023) and Schulz et al. (2014). Latent class models, a semiparametric variant of the conditional logit, share similarities with the mixed logit (Greene & Hensher, 2003). This model posits that different attributes of alternatives may influence the decision-making process differently within specific respondent groups or classes. The model assumes the existence of distinct segments or classes within a sample to account for heterogeneity. Each class shares preference weights and shows systematic variations from the preference weights of other classes (Greene & Hensher, 2003). These class-specific preference weights are estimated through conditional logit analysis within their respective segments (Hauber et al., 2016). The number of classes is predetermined by the researcher. When adapting

<sup>&</sup>lt;sup>7</sup>Given its technical equivalence and reduced risk of misinterpretation, all attribute variables are dummy-coded rather than effect-coded (Hu et al., 2022).

Equation (2) for latent class analysis, the probability that farmer n belongs to a specific latent class c can be expressed as:

$$\operatorname{Prob}_{nc} = \frac{\exp(V_{nc})}{\sum_{j=1}^{J} \exp(V_{nc})}$$
(5)

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Given the membership in class c, the probability that respondent n selects alternative j in choice situation s can be written as:

$$\operatorname{Prob}_{nsj|c} = \prod \frac{\exp(V_{nsj|c})}{\sum_{j=1}^{J} \exp(V_{nsj|c})}$$
(6)

Both the latent class model and the mixed logit have their merits. The semiparametric latent class model does not require strong assumptions about individual heterogeneity. In contrast, the fully parametric mixed logit model allows for flexible definitions of individual heterogeneity (Greene & Hensher, 2003; Hauber et al., 2016). To align the latent class model with the assumptions of the mixed logit analysis, we specify *TAC*, *interest* and *deposit* as fixed, while assuming that the *ASC*, group and compartmentalisation have a random component. Finally, the DCE enables us to estimate the respondent's WTP for selected attributes. The estimation in the so-called preference space is based on the basic model's specifications. It is defined as the marginal rate of substitution between price and quantity expressed by an attribute, given constant utility levels. This estimation in preference space, also known as the delta method (Hole & Kolstad, 2012), can be written as follows:

$$WTP_k = \frac{\beta_k}{\beta_p} \tag{6}$$

where  $\beta_k$  represents the estimated parameter of the kth attribute, and  $\beta_p$  is the estimated price coefficient. Unlike the estimation in preference space, when estimating in WTP space, one directly estimates the WTPs by essentially dividing all parameters by the price coefficient before estimation (Bliemer & Rose, 2013).

#### 3.4 | Implementation

Before presenting the choice situations, enumerators outlined a hypothetical scenario: respondents were asked to imagine they had 10,000 FCFA (15.25) in their purse that they wished to save, with two mobile phone-saving applications available for this purpose. The enumerators clarified that savings were not tied to a specific purpose, allowing for business or private expenditures, including household costs and emergencies. They then detailed the attributes and levels of each application, assuring respondents there were no incorrect choices and encouraging them to select the option best suited to their circumstances. Finally, the enumerators emphasised the opt-out alternative, allowing respondents to retain their money without using either application.

As shown in Figure 1, Alternatives A and B varied in attributes and levels, with a third optout option on every choice card. Six choice cards in each block were presented in a random order, with a dominant scenario always displayed last to assess respondent understanding. In this scenario design (see Appendix S1, superior choice set), we identified the highest interest earnings, lowest transaction cost and minimum deposit levels as dominant. We assumed respondents would prefer individual saving over group saving, and anticipated preference for the compartmentalisation option over a default account without sub-account division. Our decision to focus on individual saving is based on literature (e.g., Jakiela & Ozier, 2016; Riley, 2022), which leads us to expect participants to favour individual saving over account sharing. However, joint saving, for instance with a spouse, remained an option. We did not anticipate biases regarding the compartmentalisation feature, as participants not wishing to use this soft commitment mechanism could simply maintain their savings in one digital wallet or sub-account. To enhance answer traceability, we asked respondents to briefly explain their choice. If a respondent in the superior choice set showed a preference for the group-saving option, no matter at which cost, they could indicate this. Respondents who chose the inferior scenario in the control choice situation with the dominant scenario and failed to provide a comprehensible justification had their observation removed from the data set. Ultimately, we excluded 23 respondents who provided inconsistent responses, leaving 421 respondents for the analysis.<sup>8</sup>

# 4 | RESULTS AND DISCUSSION

#### 4.1 | Sample characteristics

Table 2 presents the sample characteristics. On average, respondents are male, 48 years old, and reside in households comprising 10 members. Mali's societal structure, characterised by patriarchal lineages and influential male household heads (Whitehouse, 2022), typically assigns financial decision-making and credit contract signing responsibilities to the male head of the household. This dynamic, coupled with our collaboration with an agricultural bank, accounts for the predominance of male respondents in our sample. The educational level of respondents is relatively low, with 84% having attended only primary school or having no formal education.

Furthermore, we surveyed respondents about the perceived difficulty of saving. A third (33%) reported an inability to save due to insufficient funds. Between 23% and 36% cited issues such as lack of a secure storage place (36%), temptation spending (31%) or difficulty in accumulating larger amounts due to requests from others (23%). The majority (87%) had not received any farming training, either formal or informal. Mobile phones and mobile money usage are prevalent, with 19% of respondents reporting proximity to a bank branch and 56% having a mobile money agent within walking distance. To demonstrate the representativeness of our sample, we compare key variables with the World Bank's Living Standards Measurement Study (LSMS) in Mali (Institut National de la Statistique [INSTAT], 2022) in Appendix S3. Our sample differs most from the LSMS data in terms of education levels. Consistent with other choice experiment literature samples (e.g., Nordmeyer et al., 2023), our sample comprises individuals with higher education levels than the general population.

## 4.2 | Mixed logit analysis

We used the mixlogit command (Hole, 2007) in Stata 15 with 1000 random Halton draws to analyse farmers' choices. The base model estimation results are presented in column (1) of Table 3. The ASC has a positive and statistically significant coefficient, indicating a generally

<sup>&</sup>lt;sup>8</sup>Overall, 31 respondents selected the choice set deemed inferior by our definition. Eight of these respondents provided reasonable justifications, such as 'Je prefere le compte en groupe parceque cela me permet de me surpasse' (I prefer the group account because it allows me to surpass myself) or 'En famille' (with the family), and thus their observations were retained. However, 23 observations were removed due to inconsistent responses, such as justifying the selection of the inferior choice set with a lower associated cost. For robustness, we performed a mixed logit analysis with 421 respondents, excluding these inconsistent responses, and with the full sample of 444 respondents (see Appendix S2). The results were qualitatively consistent across both analyses.

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#### TABLE 2 Descriptive statistics.

Variable	Unit	Mean	Standard deviation	N
Age	Years	47.53	10.91	421
Difficulty when trying to save				421
No money	0/1 (1 = yes)	0.33		
No secure place	0/1 (1 = yes)	0.36		
Requests from others	0/1 (1 = yes)	0.23		
Temptation spending	0/1 (1 = yes)	0.31		
Education (completed)				357
No education	0/1 (1 = yes)	0.55		
Primary education	0/1 (1 = yes)	0.29		
Secondary education	0/1 (1 = yes)	0.16		
University	0/1 (1 = yes)	0.03		
Gender	0/1 (1=male)	0.96		421
Household size	Individuals	10.02	5.80	356
Household revenue from farming, annual	FCFA	2,479,412	7,372,449	409
Mobile money use (at least once per week in the past 12 months)	0/1 (1 = yes)	0.89		399
Mobile money used for saving (ever)	0/1 (1 = yes)	0.38		372
Mobile phone ownership, household	0/1 (1 = yes)	0.99		421
Mobile phone ownership, individually	0/1 (1 = yes)	0.66		421
Total current savings amount, household	FCFA	623,806	1,399,586	357
Training (Farming)				421
No training	0/1 (1 = yes)	0.87		
Informal non-degree apprenticeship	0/1 (1 = yes)	0.08		
Informal apprenticeship with a craftsman	0/1 (1 = yes)	0.01		
Training in a professional training centre	0/1 (1 = yes)	0.03		
Higher technical education	0/1 (1 = yes)	0.00		
Walking to the closest bank branch	0/1 (1 = yes)	0.19		421
If walking is possible: distance	Minutes	28.96	37.42	232
Walking to the closest mobile money agent	0/1 (1 = yes)	0.56		421
If walking is possible: distance	Minutes	10.10	11.10	81

Source: Authors' calculation.

positive attitude towards the mobile-based saving solution. This aligns with literature suggesting a demand for accessible and secure saving mechanisms (Dupas & Robinson, 2013b; Steinert et al., 2018). Mobile financial services are potent tools for enhancing financial inclusion among marginalised groups, as demonstrated by Suri et al. (2021) in their study on digital credit uptake in Kenya.

However, the large and statistically significant standard deviation of the ASC indicates preference heterogeneity. As anticipated, the coefficients for *accumulated transaction costs per* 

	Base model	Specifications to detect	preference heterogeneity		
	(1)	(2)	(3)	(4)	(5)
Alternative specific constant (ASC)	4.909*** (0.524)	0.260 (1.673)	3.942*** (0.530)	5.030*** (0.604)	4.918*** (0.527)
Accumulated transaction cost/month	$-0.002^{***}$ (0.000)	$-0.002^{***}(0.000)$	$-0.002^{***}$ (0.000)	$-0.002^{***}(0.000)$	-0.002*** (0.000)
Interest amount/month	0.006*** (0.002)	$0.007^{***}$ (0.002)	$0.006^{***}$ (0.002)	$0.007^{***}(0.002)$	0.006*** (0.002)
Minimum deposit	-0.001*(0.000)	-0.000(0.000)	-0.001*(0.000)	-0.000(0.000)	$-0.001^{**}(0.000)$
Group saving	$-1.637^{***}$ (0.194)	-1.618*** (0.204)	-1.635*** (0.194)	-1.218* (0.7513)	-1.424* (0.242)
Compartmentalisation	0.079 (0.134)	0.143(0.145)	0.078 (0.134)	0.145 (0.145)	0.071 (0.133)
Interaction terms					
ASC×Age		$0.069^{**}(0.035)$			
ASC×Education		0.115 (0.423)			
ASC×Household size		$0.149^{***} (0.423)$			
ASC×Walk MM agent			$0.064^{***}$ (0.018)		
ASC×Temptation			1.289 (0.833)		
ASC×No secure place			$1.548^{**}$ (0.696)		
Group×Age				-0.007 (0.014)	
Group × Education				0.039 (0.182)	
Group × Household size				-0.007 (0.025)	
Group×Walk MM agent					-0.020(0.014)
Group × Temptation					-0.129(0.310)
Group×No secure place					-0.421 (0.279)
Standard deviation					
ASC	$4.113^{***}$ (0.401)	$2.593^{***} (0.598)$	$3.339^{***} (0.382)$	$4.458^{***}(0.486)$	$4.144^{***}$ (0.409)
Group saving	$2.319^{***}$ (0.175)	$2.180^{***}$ (0.179)	$2.319^{***}$ (0.175)	2.097*** (0.231)	$1.950^{***} (0.240)$
Compartmentalisation	$0.367^{**}$ (0.166)	$0.363^{**}(0.178)$	$0.356^{**}$ (0.167)	$0.349^{**}$ (0.189)	0.328* (0.178)
Number of observations	7578	6408	7578	6408	7578

**TABLE 3** Mixed logit model results without and with interaction terms.

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	Base model	Specifications to	detect preference heterogen	leity	
	(1)	(2)	(3)	(4)	(5)
Number of respondents	421	356	421	356	421
<sup>2</sup> x	1170	066	1152	1002	1158

3557 3661

2991 3093

3642

2981 3083

3543 3605

3539

TABLE 3 (Continued)

*Note:* Standard errors are denoted in parentheses. \*p < 0.1, \*\*p < 0.05, \*\*\*p < 0.01.

Akaike information criterion Bayesian information criterion

*"p*<0.1, *""p*<0.05, *""p*<0.01. *Source*: Authors' calculation.

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month and minimum deposit are negative and statistically significant, while the interest amount per month has a positive and statistically significant coefficient.

Respondents showed a preference against *group saving*, as indicated by its negative and statistically significant coefficient. A potential explanation of this result is that despite the potential benefits of group saving, such as increased commitment and social pressure (Kast et al., 2012), respondents may prefer to keep savings hidden from family and peers (Jakiela & Ozier, 2016; Steinert et al., 2022). It is noteworthy that our sample is predominantly male. While saving groups are traditionally popular among women (Akande & Turner, 2018), men may prefer a more individualistic saving approach. Similar to the ASC, we expect considerable preference heterogeneity, as indicated by the attribute's large and statistically significant standard deviation.

Lastly, the coefficient for *compartmentalisation* is positive but small and statistically insignificant. Given that this attribute only offers the option to earmark savings and improve fund management, the small magnitude and lack of statistical significance are somewhat surprising. We expected a stronger preference for this attribute among respondents, given the demonstrated effectiveness of partitioning financial resources (Aggarwal et al., 2023; Soman & Cheema, 2011). However, the absence of a notable effect could be attributed to the abstract nature of the attribute relative to more tangible and familiar attributes like *transaction cost* and *interest amount*.

#### 4.3 | Willingness to pay

The WTP estimates for the base specification are presented in Table 4. We derived these estimates in column (1) using the delta method, also known as WTP calculation in preference space. We observed a substantial WTP for the saving application. As anticipated, the *interest amount* has a positive but relatively small coefficient. Negative WTP values were observed for the attributes of *minimum deposit*, group saving and compartmentalisation. The negative WTP for *minimum deposit* is expected, as a higher deposit requirement limits savers' flexibility and is generally perceived negatively. As indicated by the mixed logit results, respondents appear to have varied perceptions of the innovative saving approaches, with a particularly large negative WTP for the group-saving option. WTP values may be biased when the price attribute is specified as random (Hole & Kolstad, 2012). However, since we specified the price (in our case, the monthly TAC) as fixed, we do not anticipate any bias. For robustness, we also estimated the WTP in WTP space (column (2)), which would be preferable with a random price specification (Hole & Kolstad, 2012). The results were sufficiently similar.

Attributes	WTP in preference space (1)	WTP in WTP space (2)
Alternative specific constant	2754.369	2963.684
Interest amount/month	3.438	3.054
Minimum deposit	-0.306	-0.282
Group saving	-918.669	-930.923
Compartmentalisation	44.407	38.224
Akaike information criterion	3543	3535
Bayesian information criterion	3606	3611

**TABLE 4** Mean willingness to pay (WTP) estimates in FCFA.

Note: N = 421.

Source: Authors' calculation.

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#### 4.4 | Exploring drivers of preference heterogeneity

The substantial and statistically significant standard deviations of the random parameters *ASC*, *compartmentalisation* and *group saving* necessitate an investigation into the drivers of heterogeneity. The following subsections aim to reveal these drivers through interaction terms and a latent class model.

#### 4.4.1 | Interaction terms

Columns (2)–(5) in Table 3 further scrutinise the drivers of preference heterogeneity. We interact ASC and group saving with chosen sociodemographic characteristics and potential saving barriers. To avoid model overfitting (Blackwell & Olson, 2022), we adopt the approach of Meemken et al. (2017), Platteau and Ontiveros (2021) and Shee et al. (2021), implementing four distinct, non-overlapping model specifications. Platteau and Ontiveros (2021) clarified that this non-overlapping approach is intended to reduce the risk of effects vanishing when all interaction terms are included in one specification.

In model specifications (2) and (4), the ASC and group saving interact with age, education and household size. Despite its potential interest, gender was not selected as an interaction variable given the male dominance (96%) in our sample. Age and education were chosen based on their potentially considerable impact on the readiness to adopt new technologies, specifically mobile money (Akinyemi & Mushunje, 2020; Hamdan et al., 2022). Drawing from Fromell et al. (2021) and Jakiela and Ozier (2016), we hypothesise that the number of household members will affect the overall preference for our digital saving solution, as requests for financial assistance from household members may enhance the desire for more discreet saving.

Model specifications (3) and (5) delve deeper into how saving hurdles could influence the adoption of the savings application. We interact the *ASC* and *group saving* with dummy variables indicating proximity to a mobile money agent and struggles with temptation spending and lack of a safe place. Given that travel time and cost are key components of transaction costs (Agarwal et al., 2023; Sangaré & Guerin, 2015), we predict that the ability to walk to the nearest mobile money agent will affect adoption willingness. Dupas and Robinson's (2013b) observation in Kenya that simply providing a secure place to store money significantly increased savings leads us to anticipate that respondents indicating saving barriers related to temptation spending or lack of a secure place could alter their perception of the savings application and group-saving option's attractiveness. Finally, the act of storing cash out of sight, whether in a lock box, a bank account, or in our case, a mobile account, may considerably influence an individual's self-control and adherence to their savings goals (Karlan et al., 2014).

The interaction of *age* with the *ASC* has a positive and statistically significant effect, suggesting that older respondents are more receptive to using the savings application (see Table 3, column (2)). This contradicts our expectation that younger individuals, being more tech-savvy, would be more open to such applications. Our results challenge the findings of Zins and Weill (2016), who argued that older age generally reduces the likelihood of owning a bank or mobile money account. However, in our sample, 99% of respondents have access to a mobile phone, and 89% have used mobile money at least once in the past 12 months (see Table 2), indicating that they have already surmounted a considerable hurdle to opening a mobile account. One possible explanation for this could be the older respondents' wish to securely transfer savings to their children.

Furthermore, consistent with our initial expectations (Akinyemi & Mushunje, 2020), *education* positively correlates with the overall preference for the application, although this correlation is not statistically significant. We also find that as household size increases, respondents show a greater inclination towards using the application. This could be attributed to the need to maintain confidentiality about the exact amount of savings, which may be challenging with more cohabitants (Jakiela & Ozier, 2016; Riley, 2022).

In column (3), we find a positive and statistically significant relationship when the respondent's ability to walk to the nearest mobile money agent interacts with the ASC. This supports our expectation that mobile money providers need to establish a comprehensive agent network to cater to potentially remote clients (Akinyemi & Mushunje, 2020; Lashitew et al., 2019). If reaching the nearest mobile money agent is too burdensome, individuals might be deterred from using this technology. The other two interaction terms in column (3) are positive as well, suggesting that respondents who report perceived hurdles to saving tend to prefer the application over the opt-out option. This implies that such an application might be useful for aspiring savers who struggle with temptation spending or lack a safe place, although only the interaction with no secure place is statistically significant.

Given the high standard deviation observed in the group-saving attribute, further exploration of the underlying heterogeneity is warranted. Savers participating in saving groups could potentially benefit from group dynamics that help them adhere to plans (Karlan et al., 2014; Kast et al., 2012). In column (4), we find negative relationships when interacting *group saving* with *age* and *household size*, indicating that older respondents and those with larger households do not prefer the group-saving attribute. The interaction with *education* is positive, suggesting that better-educated individuals have a higher preference for group saving. However, none of these interaction terms is statistically significant.

In column (5), we examine the interaction between *group saving* and the proximity of a mobile money agent as well as the struggle to save given the temptation of spending or the lack of a safe place. All interaction terms are negative, yet not statistically significant at conventional levels. This could suggest that while individuals may recognise temptation spending as an issue, they do not view group saving as a viable solution. This could be attributed to individuals without formal saving options being interested in securely and privately storing cash on their mobile accounts, but reluctant to disclose their actual savings to others (Jakiela & Ozier, 2016; Riley, 2022).

## 4.4.2 | Latent class analysis

To enhance our analysis and identify further preference heterogeneity, we utilise a latent class model. This model allows us to segment the pooled sample into smaller sub-groups and examine their distinct preferences. The latent class model addresses the IIA by allocating respondents with different preferences to various latent classes, which can be characterised by selected sociodemographic variables. In this model, preference estimates can vary between classes but remain homogeneous within each class (Boxall & Adamowicz, 2002).

We implemented the latent class model estimation using the *lclogit2* package in Stata 15 (Yoo, 2020). To ascertain the optimal number of classes, we employed the corrected Akaike information criterion (AIC), following Weissgerber and Hess (2022). Our analysis considered two and three classes. Due to non-convergence issues with more than four classes, three classes proved to be the best fit. This finding aligns with Zhou et al. (2018), who reported in their metaanalysis that 80% of the reviewed publications identified two to three classes. Table 5 presents the results. Consistent with our mixed logit model specifications, we assumed that farmers uniformly prefer to minimise costs and maximise returns. Thus, we defined *TAC*, *interest amount* and *minimum deposit* as fixed. This approach aligns with Lara-Pulido et al. (2021), who used *lclogit2* to constrain an attribute indicating a usage fee in their latent class model. Our latent class analysis identified three groups. The first group, comprising 19% of the respondents, is the smallest. Classes 2 and 3 include 31% and 50% of the respondents, respectively.

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	Class 1 (19%)	Class 2 (31%)	Class 3 (50%)
Alternative specific constant (ASC)	-1.068*** (0.369)	2.977*** (0.558)	4.141*** (0.424)
Group saving	-1.137*** (0.258)	0.939*** (0.229)	-2.210*** (0.192)
Compartmentalisation	0.624** (0.249)	0.532*** (0.194)	-1.179 (0.153)
Fix			
Accumulated TAC/month	-0.001*** (0.000)		
Interest amount/month	0.005*** (0.002)		
Minimum deposit	-0.000 (0.000)		
Selected descriptive variables (Cla	ss 3=reference group)		
Age	-0.025* (0.016)	-0.022* (0.015)	
Education	0.008 (0.198)	-0.081 (0.191)	
Household size	-0.057** (0.029)	0.012 (0.025)	
Walk MM agent	-0.046 (0.047)	-0.045 (0.047)	
Difficulty saving: temptation	0.331 (0.336)	0.084 (0.318)	
Difficulty saving: no secure place	-0.631* (0.351)	-0.503 (0.307)	
WTP coefficients (in FCFA)			
ASC	-776.442**	2165.575***	3011.041***
Group saving	-827.266***	682.598***	-1600.000***
Compartmentalisation	453.615**	387.036**	-130.494
Number of observations			6408
Number of respondents			356
Akaike information criterion (AIC)			3086
Bayesian information criterion (BIC)			3262

**TABLE 5** Latent class analysis and willingness to pay (WTP) results.

*Note*: Standard errors are denoted in parentheses; for latent class models with 2 classes: AIC=4022 and BIC=4113. \*p < 0.1, \*p < 0.05, \*\*p < 0.01.

Source: Authors' calculation.

Respondents in Classes 2 and 3 exhibit a strong and statistically significant preference for the saving application. Conversely, 19% of respondents in Class 1 prefer the opt-out alternative. For *group saving*, Classes 1 and 3 have a negative and statistically significant coefficient, indicating a preference for individual saving (default) over shared saving accounts. Class 2 respondents, however, favour the group-saving option. While Classes 1 and 2 prefer the compartmentalisation feature, the value for *compartmentalisation* in Class 3 is negative, although not statistically significant. As anticipated, the two cost parameters, *transaction cost* and *minimum deposit*, are negative, while *interest amount* is positive.

We characterised the different classes using the same descriptive variables as in the mixed logit model, with Class 3 serving as the reference group. Respondents in Class 1 are slightly younger than those in Classes 2 and 3, a statistically significant difference at the 10% level. They are also more educated, live in smaller households (statistically significant), are less likely to live within walking distance of the next mobile money agent, and are more likely to experience saving difficulties due to temptation spending. Compared with Class 3, a higher proportion of Class 1 respondents do not perceive the lack of a safe place as a barrier to saving, a statistically significant difference.

Respondents in Class 2, who are marginally younger, less educated and reside in larger households than those in Class 3, are less likely to have access to a nearby mobile money agent. They perceive fewer challenges in saving given issues of temptation spending but report that the absence of a secure place hinders their saving efforts. *Age* is the only variable that is statistically significant at conventional levels.

When we consider attribute preferences in conjunction with these descriptive variables, it becomes apparent that younger individuals tend to prefer the *compartmentalisation* attribute. Similarly, those who do not view the absence of a secure savings place as a barrier also lean towards compartmentalising their savings. The preferences for the group-saving option and the application, in general, are less definitive. Overall, the selected descriptive variables do not provide a clear indication of how sociodemographic factors and saving barriers might influence preferences for saving attributes.

We also estimate the WTP for the ASC, group saving and compartmentalisation attributes. Class 1 respondents exhibit negative WTPs for the ASC and group-saving attributes, but a positive WTP for the compartmentalisation option. In Class 2, the WTPs for the ASC and the two attributes are positive, while in Class 3, only the WTP for ASC is positive, with negative WTPs for group saving and compartmentalisation. As noted by Schulz et al. (2014), the WTP values are similar but do not align perfectly with the WTPs derived from the mixed logit analysis. These values should be interpreted with caution and viewed as reference points rather than precise estimates.

# 5 | CONCLUSION

The promotion of savings and optimised household financial planning are increasingly recognised as effective policy tools for sustainable cash-flow management and consumption smoothing, particularly among marginalised societal groups (Karlan et al., 2014; Steinert et al., 2018). Numerous studies have explored various saving mechanisms, deviations of rational decision-making behaviour and norms associated with saving in low-income economies (e.g., Aggarwal et al., 2023; Dupas & Robinson, 2013a; Steinert et al., 2022). This study integrates findings from these studies into a DCE, focusing on behavioural mechanisms to identify Malian farmers' preferences for a digital saving solution that could help mitigate behavioural biases.

The mixed logit model results suggest a strong preference for digital savings over keeping cash at hand. Our respondents are price-sensitive, favouring lower transaction costs and deposits and higher interest payments. The compartmentalisation attribute is valued, although not statistically significantly, while the group-saving attribute is less popular. A latent class model allows us to categorise participants and gain a more nuanced understanding of their preferences. Approximately one-third of the respondents value digital saving with peers, while two-thirds prefer individual saving. Additionally, 50% of respondents show a statistically significant and positive preference for the compartmentalisation option.

There is substantial evidence that impoverished individuals utilise a variety of saving devices, ranging from locked boxes or zip bags to saving groups or mobile money (Aggarwal et al., 2023; Karlan et al., 2014; Steinert et al., 2022). Our study contributes to this body of research by demonstrating that these individuals seek secure and affordable saving options and are willing to pay for such services despite being cost-sensitive. This presents a unique revenue-generating opportunity for mobile network operators and banks.

Our findings lead to several policy recommendations. Given the high acceptance of digital saving relative to keeping cash, policymakers should promote and facilitate the development and use of digital solutions, such as mobile saving applications. This could be achieved through awareness campaigns, financial literacy programmes and partnerships with mobile network operators to ensure widespread access and affordability. As our study shows, our participants are cost-aware. Therefore, we recommend addressing the rural poor by reducing substantial cash

withdrawal costs and increasing accessibility in remote areas. This could make digital saving more attractive than traditional and potentially riskier saving methods.

Moreover, acknowledging the importance of compartmentalisation and earmarking of savings, policymakers should advocate for mobile financial service providers to incorporate features that enable users to allocate their savings for distinct purposes. Such mechanisms have already been demonstrated to be effective in previous research (Aggarwal et al., 2023; Soman & Cheema, 2011). This flexibility and customisation can empower individuals to manage their finances more effectively and strive towards their financial objectives. Given the considerable variation in group-saving preferences, mobile financial service providers should provide both individual and group-saving options to cater to diverse user preferences. This approach recognises users' varied needs and preferences, ensuring that saving products are inclusive and accessible to a broad spectrum of individuals.

Although we adhered to established methodologies for designing DCEs, it is important to acknowledge the inherent limitations of the stated preference approach. One prevalent concern is the potential for hypothetical bias, potentially resulting in overestimated WTP values. Although we made efforts to mitigate this bias in our study, we cannot entirely dismiss its influence and recommend interpreting the values as approximations instead of exact estimates. Another limitation linked to our experiment's hypothetical nature is that our innovative attributes might appear abstract to the respondent, compared with the other, more familiar and tangible attributes. For instance, we expected a stronger preference for the compartmentalisation attribute given the demonstrated effectiveness of partitioning financial resources (Aggarwal et al., 2023).

While we believe our results possess high external validity and are transferable to other rural households in low-income countries, we recommend future research to focus on comparing saving preferences between male and female savers. Additionally, it could be insightful to investigate how our findings apply to specific areas of agriculture, such as the impact of saving opportunities and preferences on-farm management decisions like crop selection or input utilisation.

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#### **CONFLICT OF INTEREST STATEMENT**

The authors declare no conflicts of interest.

#### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

#### ETHICS STATEMENT

For this research, ethical approval was obtained by the German Institute of Development and Sustainability (IDOS). The authors have obtained clearance from the ethics board of the University of Göttingen, Germany.

#### PERMISSION TO REPRODUCE MATERIAL FROM OTHER SOURCES

The authors declare that no excerpts from copyrighted works owned by third parties are included.

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#### SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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