Exploring the Mobile Money in the Financial Inclusion Landscape in Burundi: Impacts in Gender and Location Perspectives

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Abstract

Mobile money is a good example of the technological revolution through the digitalization of the banking system. However, the advantages offered by this new technological revolution has never been deeply explored with perspectives of existing gender and location gap in terms of financial inclusion. The present study explored the existence of policy/Regulations of Mobile Money in Burundi, the determinants of use of mobile phone and mobile money as well as the intensity of use of mobile money services and the mobile money usage impacts on gender and location perspectives on livelihood outcomes. The study used primary data collected in five different provinces. The study found that the mobile money ecosystem is governed by three different entities without a legal platform gathering them, moreover, the mobile money system is regulated by same text governing payment institutions. Furthermore, the access to electricity, alternative ways of recharge in case of lack of electricity and type of occupation of the household head were found to have a positive and significant influence on thrive, use of mobile phone, registration for mobile money and intensity of use of mobile money services. Education level, remittances, and location (urban vs rural) were found to have a positive and significant influence on both the registration and intensity of use of mobile money services. The study found also that the use of mobile money positively influences the quality of food consumption as well as the economic status proxied by wealth Index. No gender gap was found on food consumption for both wealth assets index and food consumption among the mobile money users. A significant gender gap was found both in wealth assets index and food consumption scores for mobile money non-users. A location food consumption gap was revealed for both mobile money users and non-users but with a significance skewed to mobile money nonusers' households. A gap on location wealth assets was spotted out in favor of urban households for both mobile money users and non-users.

1. Introduction

The financial system in Burundi has encountered significant obstacles, including fragmentation, inequities, financial fragility, and the impact of political risks, low rate of bank penetration, all of which have been shaped by the historical context of the country (Ndikumana, 2014; Nimubona, 2022; Grauvogel, 2016). The country is now facing significant challenges in achieving widespread financial inclusion. According to the World Bank, only 3.5% of Burundi's adult population has access to formal financial services, leading to the exclusion of most from the established financial system (AFI, 2015; BRB, 2012) with significant gaps in account ownership 41% in urban areas compared to only 8.5% in rural areas. Additionally, men are twice as likely to own an account compared to women, exacerbating the financial exclusion, which stands at a staggering 73% in Burundi (BRB,2012, Mbang et al 2022), while it's 30% in Uganda, 52% in Rwanda, 54% in Tanzania, in terms of Bank account ownership (BRB and AFI, 2012).

Various development initiatives are emerging to address this issue. Microfinance institutions, such as WISE established in 2007, primarily support small and medium-sized women-led businesses. The recently established Investment and Development Bank for Women (BIDF) prioritizes women's economic and business initiatives for credit. Furthermore, organizations engaged in agriculture and rural development aim to enhance the financial inclusion of rural populations this the case of the IFAD project PAIFAR-B (Burundi Agricultural and Rural Financial Inclusion Support Project) which is targeting to strengthen the financial inclusion of rural agricultural and non-agricultural populations. However, the effectiveness of these initiatives depends on adequate infrastructure such as roads, electricity, and internet availability in rural Burundi. Physical distance to financial service points remains a major barrier to financial inclusion, necessitating the provision of services closer to these populations.

Mobile money presents a promising avenue for improving financial inclusion and serves as a catalyst for financial inclusion by facilitating access to savings, credit, insurance, and various financial tools for those previously excluded from traditional banking services with a proven impactful global footprint (Barajas et al., 2020 and Fanta et al., 2016; Okello et al., 2018; Boro, 2017; Amoah et al., 2020; Myeni et al., 2020). Evidence from the literature (Abor et al., 2018; Brune et al., 2011; Burgess and Pande, 2005; Shetty and Veerashekharappa, 2009; Swamy, 2014) has proven the reduction in social inequalities due to financial inclusion through the use of mobile money system. However, its expansion requires robust regulations and security measures

to ensure consumer protection, prevent fraud, and foster fair competition. Studies (Gichuki, 2018; Asravor, 2022; Akinyemi, 2020; Afawubo, 2020; Munyegera, 2016; Gosavi, 2018) have shown varying patterns of mobile money adoption based on gender and geographical location and highlighted that women often face more significant barriers to accessing formal financial services due to societal norms and location disparities between urban and rural basically due to differences in infrastructure, access to technology, and financial literacy. These studies pointed out that mobile money provided a more inclusive platform, empowering women by granting them control over their finances, facilitating savings, and enabling entrepreneurship opportunities. It's important to note that more than 80% of the Burundian population resides in rural areas, with 50.4% being female (World Bank, 2022). The labor force participation exceeds 80% among women and reaches 78% among men (Megerle et al, 2020; Ornella, 2019). Excluding most of the population and labor force from the financial system hampers the country's national policy objectives and impedes its contribution to global agendas like the Sustainable Development Goals.

Leveraging existing mobile networks and technologies, mobile money can extend financial services to remote areas, bridging the gap between the unbanked population and formal financial institutions in Burundi (BRB, 2012; Shankar, 2013; Kunt, 2012; Ranjani et al, 2015; Agyemang-Badu et al., 2018; Pomeroy et al., 2020; Ambarkhane,et al, 2022; Atta-Aidoo et al, 2023). The current study aims to explore new opportunities presented by digital finance, focusing on financial inclusion innovations such as mobile money and the supporting system and environment. While previous studies (Ntahomvukiye, 2021; Abel 2020; Gildas, 2022; Atta-Aidoo, 2022) have explored mobile money in Burundi, they have overlooked the policy framework governing the mobile money ecosystem and have considered mobile money among other aspects of financial inclusion. This study intends to fill this gap by exclusively concentrating on the role of mobile money in the financial inclusion landscape and its impacts.

General objective

The general objective of this study is to assess the role of mobile money and financial inclusion in livelihood outcomes in gender and location perceptive.

Specific objectives

i. To explore the policy environment of mobile money in Burundi.

ii. To assess the level, intensity, and determinants of use of mobile money in gender and location perspectives.

iii. To analyze the difference between rural and urban areas, women, and men in terms of livelihood outcomes impacts of mobile money.

2. Review of the literature

Digital finance and financial inclusion: Context and issues

The outcome of a prolonged and inconclusive debate on the definition of financial inclusion and its dimensions illustrates the varying perspectives among researchers. Initially, financial inclusion was defined solely based on access to formal financial services but was later expanded to encompass additional dimensions such as usage, cost, and quality of financial services for a larger portion of the population (Demirgüç-Kunt et al., 2013). According to the World Bank Group, as cited by Wamba et al., (2021), "Financial inclusion means that individuals and businesses have access to useful and affordable financial products and services that meet their needs for transactions, payments, savings, credit, and insurance delivered in a responsible and sustainable way" (Wamba et al.,2021). Shahulhameedu (2014) defined financial inclusion as the availability of low-cost bank services to disadvantaged and low-income communities (Shahulhameedu, 2014).

Digital financial inclusion refers to the accessibility and utilization of formal financial services and products through digital means, such as mobile phones and the internet, to ensure the participation of individuals and communities in the financial system. It encompasses the provision of affordable and convenient financial services, including savings, credit, insurance, and payment systems, to previously underserved or excluded populations. Digital financial inclusion aims to promote economic empowerment, reduce poverty, and enhance financial stability by extending financial services to marginalized and remote areas, thereby fostering inclusive economic growth and development Khera et al. (2022). This concept has gained significance in the context of emerging markets and developing economies, where digital finance has the potential to bridge the gap between traditional financial services and underserved populations, thereby promoting financial resilience and economic well-being (Cheumar & Yunita, 2022).

The adoption of digital financial services to address financial inclusion in poor African countries is a multifaceted issue influenced by various socio-demographic characteristics, government policies, digital technology, and business regulations. Research has shown that poorer and less educated individuals, as well as the young, are disproportionately excluded from the financial system, highlighting the need to understand the specific challenges faced by these groups (Amari & Jarboui, 2021).

Additionally, stakeholders, governments, and supporters are encouraged to endorse the sustainable adoption of digital finance and business environment to assist low-income citizens in achieving improved living standards (Yakubi et al., 2022).

However, there are significant challenges to achieving financial inclusion through digital finance, including illiteracy, poor infrastructure, power supply issues, and data privacy breaches, especially in rural areas (Ediagbonya & Tioluwani, 2023).

Furthermore, the impact of digital technology and business regulations on financial inclusion and socio-economic development in low-income countries is crucial. Digital finance has the potential to lead to greater financial inclusion, expansion of financial services to the non-financial sector, and the provision of essential services to individuals (Yakubi et al., 2022). It is also essential to address the issue of financial inclusion as a tool to alleviate poverty and increase the well-being of the poor and low-income people (Maouloud et al., 2021). Microfinance has been identified as a means to address access barriers and extend the outreach of financial products and services to the poor and vulnerable, providing them with access to the formal banking system in an affordable and hassle-free manner (Singh & Padhi, 2019).

Mobile money, as a form of digital finance, is defined as a package of financial services accessible to consumers through mobile phones. Common uses of mobile money include balance checking, cash deposit and withdrawal, money transfer, and bill payments (Anyasi et al., 2009; Davids, 2012; Donner et al., 2008). The adoption and usage of mobile money services have been positively associated with the financial inclusion especially among low-income groups due to its easiest affordability and accessibility as evidenced by Myeni et al. (2020), and through the easy connection of traders in branchless banking (Mpofu, 2022; Bongomin & Ntayi, 2020). The impact of mobile money on financial inclusion has been further supported by findings that mobile transfer of funds, payment for goods, account management, and credit facilitation significantly influence financial inclusion in economies (Isabwa, 2021).

The determinants of adoption of mobile money services to address financial inclusion varies across countries and is very complex in African countries context. Mahmud (2019) examined factors influencing mobile money adoption in seven African countries and revealed that adoption is affected by country-specific characteristics, regulatory considerations, and service delivery characteristics. Bongomin et al. (2019) highlighted that mobile money services can provide access to additional financial services such as interest-bearing savings, credit, insurance, and investment products, thereby contributing to financial inclusion. Ky et al. (2018) found that mobile money may increase the probability of disadvantaged categories, such as women, individuals with irregular income, those with lower education levels and more broadly rural communities, to make deposits in bank and credit union accounts, indicating its potential to address financial inclusion barriers. Moreover, Museba et al. (2021) pointed out the role of social networks and interactions in driving mobile money adoption, particularly among early adopters and mobile technology leaders. Coulibaly (2021) identified determinants related to the least vulnerable social categories, such as gender, age, education, wealth, and workforce participation, as drivers of mobile

money adoption in both the West African Economic and Monetary Union (WAEMU) and East African countries. Mothobi (2017) found that mobile phone adoption is determined by the availability of infrastructure in the region, while mobile phone use for financial services is negatively correlated with good infrastructure; Akinyemi (2020) examined the determinants of adoption of mobile money technology in rural areas and found that age, education level and unemployment determine both adoption and use of money mobile system. Meli (2022) examined the socio-economic factors determining mobile adoption and usage in Cameroon, and found that age, level of education, standard of living and ownership of a mobile phone influenced both adoption and use of mobile money services. Asravor (2022) assessed adoption and usage intensity of mobile money services using cross-sectional data and found that household size, marital status, farm size, access to electricity, and type of occupation affect the decision to own mobile money, while age, level of education, marital status, and distance between home and agent mobile money have influenced the use of mobile money services. Al-hashfi et al (2020) assessed the determinants of mobile money usage. The study found that age, education, and use of online transactions influenced mobile money adoption.

In the context of Burundi, it is essential to consider the specific socio-economic factors influencing the adoption of mobile money services to address financial inclusion. Understanding the determinants of mobile money adoption and usage in Burundi is crucial for developing targeted strategies to promote financial inclusion in the country. Additionally, the impact of mobile money on financial inclusion and economic development in Burundi needs to be further explored to inform policies and interventions aimed at promoting sustainable and inclusive mobile money usage in the country.

Financial inclusion and livelihood's outcomes.

The relationship between mobile money adoption and livelihood outcomes is very broad and its impact has been extensively studied in various contexts. Mobile money can positively influence food consumption by enabling individuals to conveniently access and purchase food, particularly in areas with limited physical access to traditional banking services. Research has shown that consistent use of mobile money to access social and economic services can promote financial inclusion, financial empowerment, and general well-being, particularly in poor countries. For instance, the adoption of mobile money has been found to positively impact household outcomes such as farm output, welfare, and wealth among smallholder farmers in Ghana and Uganda, indicating its potential to enhance livelihoods in rural agricultural settings. Moreover, mobile money adoption has been associated with economic empowerment for informal businesses, leading to greater access to start-up capital, new employment opportunities, and improved financial management. Furthermore, the adoption of mobile money has been linked to the promotion of women's economic

empowerment, with the impact being greater when women are equipped with proper financial management skills. Additionally, mobile money adoption has been found to positively influence sustainable developmental goals, including gender equality, decent work and economic growth, and reducing inequalities. Studies have also indicated the correlation between mobile money and livelihood outcomes, offering valuable insights. For example, Munyegera et al. (2016) demonstrated that households adopting mobile money experienced an increase in per capita consumption, indicating a positive impact on food consumption. Kikulwe et al. (2014) indicated that mobile money use had a positive impact on smallholder farm household income, attributed to higher remittances for mobile money users. Mothobi (2017) revealed that mobile money can enhance the livelihoods of rural individuals by providing financial inclusion and access to financial services. Wieser et al. (2019) evaluated the impact of mobile money on poor households in remote areas, using the labor market, food security, and poverty as indicators. Food security was assessed by the strategies employed to address food shocks, with results indicating that the availability and adoption of mobile money services in remote areas altered households' strategies for coping with food shocks, with individuals opting for work instead of adjusting their diet. Similarly, the deployment of agents increased household food security and reduced the likelihood of skipping meals. It is evident that the selection of indicators to be used should consider potential limitations and the purpose of each study, influenced by data availability and the socio-economic context of the study area.

The gender dimension in the financial inclusion and its impacts

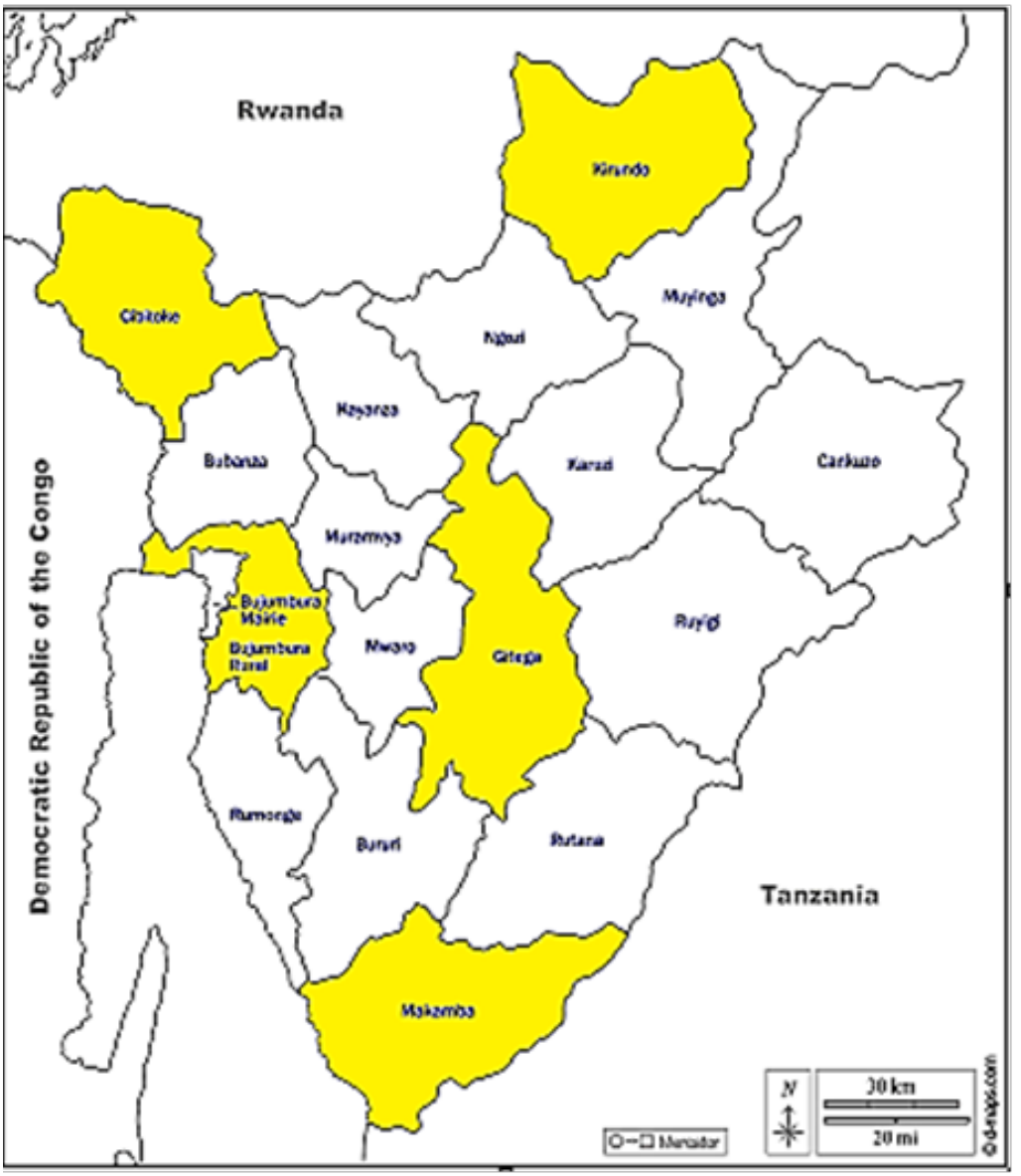
The gender theory of mobile money is part of the broader gender and development discourse, particularly within the context of financial inclusion. Gammage et al. (2017) argue that improved financial inclusion can help reduce gender inequalities, echoing the findings of various authors who have highlighted significant benefits at both individual and household levels when women have access to financial resources. For instance, Swamy (2014) observed that women use resources in ways that enhance family well-being and lead to increased household savings. However, these positive developments are challenged by societal norms and institutions that shape attitudes and behaviors, ultimately influencing gender roles and access to resources, including digital finance and mobile money (Gammage et al., 2017; Shibata et al., 2020). Despite the expansion of financial services, the persistence of gender and poverty gaps suggests that financial inclusion, including mobile money, is susceptible to biases related to gender and location (Demirgüç-Kunt et al., 2013).

3. Methodology

Study area

The present study was conducted in Burundi. one of the Great Lake Countries located on 3 25 S, 29 55 E with a total area of 27,830 square km (land: 25,680 square km and water: 2,150 square km). Burundi is surrounded by Rwanda to the north, Tanzania to the east-south, the Democratic Republic of the Congo to the west, and bordered by Lake Tanganyika to the southwest. With a population of 12.5 million people (2021) Burundi has one of the highest population densities in Africa (463 per square km or 1,199 people per square mile). The population of Burundi comprises of 86.2% rural population whose major livelihood strategy is agriculture (The World Fact Book, 2021). The country is administratively divided into three divisions, the largest of these divisions are the provinces (18 total provinces), followed by “communes” or municipals (117 communes in total), and the lowest administrative unit being 2,638 “collines” or hills/villages (2,638 collines in total).

1 Map of Burundi Showing where the Survey was Conducted (Highlighted in Yellow)



Legend: Area of study; Other Provinces; Provinces Borders.

Sample selection

The present study used primary data which were collected in five provinces of Burundi. The choice of provinces of interest were guided by two major criteria, first the provinces bordering with neighbor countries (Rwanda, DRC, Tanzania) and the two capitals of Burundi (Economic and Political). Based on the stated criteria, the provinces of Cibitoke, Gitega, Makamba, Kirundo and Bujumbura were selected.

The sample size was drawn following Yamane Taro, 1973 formula: $n = \frac{N}{1 + Ne^2}$

Where *n* = sample size to be drawn in *N* that represents the population size and *e* the level of the precision which always set the value of 0.05. This latter also represents the error (0.05) reliability level 95%. I the present study, the population size used is N = 1695252 households referring to the population size base for the 2019-2020 Living Standards Survey((ISTEEBU, 2021)

Hence, $n = \frac{1\,695\,252}{1 + 1\,695\,252 * 0.05^2} = 399.8235849 \simeq 400$

However, relying on the assumption saying that the larger is the sample size, greater is the power of prediction (Richter, 2019), combined with available resources, researchers decided to add 30% of the computed sample size to mitigated potential risks related to inaccuracy and missing data in some observations. At the end, the sample size reached 517 households.

A multi-stage cluster probability sampling with stratification was adopted to draw the sample of 517 households represented by their heads (Men and Women) with a criterion of having 18 years old and above to qualify as respondent.

The stratification was done in each province with respect to urban and rural areas where in each of the provinces one urban commune and one rural commune were selected to amount ten communes considered for our study survey. Furthermore, in each commune, 25 households led by men and women were randomly selected.

Table 1 Distribution of Respondents by Province and Communes

Province	Frequencies	Percent	Cum.	Commune	Frequencies	Percent	Cum.
Bujumbura	90	17.41	17.41	**Mugina**	54	10.44	10.44
Cibitoke	122	23.6	41.01	**Bwambarangwe**	50	9.67	20.12
Gitega	100	19.34	60.35	**Gitega**	70	13.54	33.66
Makamba	104	20.12	80.46	**Kibago**	52	10.06	43.71
Kirundo	101	19.54	100	**Kirundo**	51	9.86	53.58
Total	517	100		**Bugendana**	30	5.8	59.38
				Muha	51	9.86	69.25
				Mukaza	39	7.54	76.79
				Nyanza-Lac	52	10.06	86.85
				Rugombo	68	13.15	100
				Total	517	100	

Data were collected using a structured questionnaire integrated into Kobo toolbox to facilitate data collection. The questionnaire was organized around three major sections: Socioeconomic profile of respondents, information regarding the use of mobile phone, mobile money, and the frequency of use; and the last section was about the asset ownership and type of food consumed by respondents.

Methods: Econometric framework and estimation techniques

The Present study used mixed methods (Qualitative and Quantitative) to address its objectives. The Qualitative part was used to assess the existing policies environment regarding the use of mobile phones as well as mobile money, and some focus group discussion to complete some hanging information from quantitative analysis. The second part was the Quantitative methods which made use of econometric methods. The econometric specification of our study comes in three major parts: first, individuals' motivation to own a mobile phone and to register for mobile money account, was modelled using a logistic regression model; second, the determinants of the intensity/extent of use of mobile money services which was analyzed using a Poisson regression model and a negative binomial regression model, and thirdly, the possible impact of the use of mobile phone on food security outcomes.

Mobile money policy assessment

This study's first objective is to investigate the policy landscape of mobile money in Burundi. The aim is to evaluate the overall structure of the mobile money policy. To achieve this, four key players in mobile money policy decision-making were identified and approached as key informants: the Central Bank (BRB), the Agency of Regulation and Control of Telecommunications (ARCT) in Burundi, the Burundi Revenue Authorities, and mobile network operators. However, only two key actors agreed to be interviewed. To guide the interviews, a structured interview guide was created, drawing on existing mobile money policy assessment tools used by various authors, such as Di Castri (2013), Bahia et al. (2020), and the Mobile Money Policy and Regulatory Handbook developed by Maina (2018). Based on the review of these studies, 10 dimensions were developed to assess the policy environment.

Table 2 : Dimensions used for policy assessment.

I. Authorization:	Inspect and assess the eligibility to offer mobile money services including the criteria to offer different working approval like license, the relevant authorization instruments.
II. Storage and safeguard of customer funds:	To ensure mobile money users' funds are effectively safeguarded, mobile money providers must follow guidance on how to adequately safeguard customer funds based on the existing instruments imposed in the country by competent institutions. Our aim is to know if such instruments exist and how they work.
III. Capital Requirements:	As for bank institution, non-Bank mobile money issuers are also required to meet minimum capital requirement to get operating license. This is a prudential rule, and it is set with different function but the target to our case is to know if such policy exists and how protective it is to creditors in case of insolvency risk and guarantee the functionality.
IV. Anti-Money Laundering and Countering Financing of Terrorism:	This is to check if policy or regulation regarding the control and traceability of all transactions done by Customers to reduce the risk of money laundering and terrorist financing.
V. Know-Your-Customer (KYC) Requirements	examines the permitted identification requirements, the proportionality of KYC requirements, and the guidance provided by regulators on ID requirements.
VI. Agent network and supervision:	This is to check if mobile money providers examine the eligibility criteria for agents, their authorization requirements, agent permitted activities and agent liability.
VII. Consumer protection:	Examines the general consumer redress and disclosure mechanisms and the provisions for safeguarding of customer funds, including measures to protect customer funds in the event of bank failure.
VIII. Interoperability:	The aim here is to know how this is governed given that it requires the collaboration of all operators that entered into the agreement, and how the transaction costs are fixed.
IX. International Remittances:	The aim here is to know if such transaction exists using mobile money services, if there are policies or regulations that governs it.
X. Taxation:	The aim here is to understand how the transaction taxes are fixed, by who? And under which law or regulation

Determinants of mobile phone use, registration for mobile money and Intensity of use of Mobile money services

The study wants to assess the determinants of respondent's decision to own a mobile phone, decision to have a mobile money account after owning a mobile phone, and the intensity of using of mobile money services. Two separate binary regressions models were used to assess the determinants of both mobile phone ownership by the household head, and registration for mobile money account. Two models are largely used when the outcome is binary. The choice of logit model over probit model is explained by the fact that logistic uses the distribution function as indicated, whereas the probit model uses the standard normal distribution function, the logit model has flexibility in interpretation it can use odds ratio or marginal effect, which is not the case for probit (Wooldridge, 2005) and the hypothesis relaxing the linearity between dependent and independent variables.

A. Logistic regression model

In our case the decision to own a mobile phone (MOPO) or mobile money account (MMOACC)

$$(MOPO/MMOACC) = \begin{cases} 1, & Y_i^* = \alpha + \beta_i + \epsilon > 0 \\ 0, Otherwise \end{cases} \quad (1)$$

Where Y_i^* is an unobserved latent variable measuring the utility derived from holding (*MOPO*/*MMOACC*). If Y_i^* is greater than zero, the observation a is associated with the positive utility of holding (*MOPO*/*MMOACC*), then the individual is likely to use/register for the (*MOPO*/*MMOACC*). Accordingly, (*MOPO*/*MMOACC*), is a limited dependent variable. The error term ε is unobservable and follows a standard logistic distribution. α is the constant term and βx is a vector of m explanatory variables likely to influence both the adoption decision that of using/register for (*MOPO*/*MMOACC*), for a single observation i of the sample of n observations, denoted by xi corresponding to the coefficients βk. Which can be rewritten as: βx = β1xik +...+ βk xik, with k = 1,2, … m. The objective is to determine the probability that:

$$Pr[(MOPO/MMOACC=1)/x] = Pr[(MOPO/MMOACC=1)] / (x_1, \ldots X_k) \quad (2)$$

To avoid the restrictions of the linear probability model, we consider the following binary response model:

$$Pr[(MOPO/MMOACC=1)/x] = L((\alpha + \beta(x)) = L(z) \quad (3)$$

Where z is a linear function of our explanatory variables and L is a nonlinear function that takes values in the interval $0 \prec L(z) \prec 1$ for all real numbers z. Here, the nonlinear function L belongs to the family of logistics functions defined as follows:

$$\text{Pr MOPO/MMOACC} = L(z) = \frac{e^{(z)}}{1 - e^{(z)}} = \pi(z) \quad (4)$$

Taking values in the interval 0 and 1 for all real numbers z. π(z) is a cumulative logistic function for a standard logistic random variable. Equation (d) can be interpreted as the probability that MOPO/MMOACC = 1. We can now deduce the inverse of the logistic function π(z) logit or ln (odds) to obtain the linear expression:

$$\text{Log it } [\pi(z) = \ln\left(\frac{\pi(z)}{1 - \pi(z)}\right) = \beta 0 + \beta x \quad (5)$$

Rewriting equation (e) leads to the estimation of the final econometric logit model:

$$\ln(\text{odds}) = a + \beta_1 X_{ik} + \ldots\ldots + \beta_k X_{ik} \quad (6)$$

With k = 0, 1…, *mi* = 0, 1, …, *n*.

B. Determinants of the intensity of use of mobile money services

The Poisson regression model is the most appropriate method for analyzing the intensity of adoption given its nature of data which is count data and not ordering (Greene, 2007). We adopted the standardized poison regression model for this study. The standardized Poisson used for this study was specified in equation (7) as follows:

$$Prob(Y = y_i | x_i) = \frac{e^{\lambda_i} \lambda^{y_i}}{y_i!}, \quad y_i = 0, 1, 2, 3 \quad (7)$$

From equation (4), $\lambda_i = E(y_i \mid x_i) = Var(y_i \mid x_i)$ and the mean is commonly formulated as $y_i = \exp(x_i \beta)$ where x_i is a vector of socioeconomic characteristics of the individual *i* and β is a vector of unknow parameters to be estimated. The marginal effects in the Poisson regression model were then computed as specified in equation (8):

$$\frac{\P E(y_i | x_i)}{\P x_i} = \lambda_i \mathrm{b} \quad (8)$$

The obtained marginal effect is then interpreted as a unit change in the intensity of adoption resulting from a unit change in the explanatory variable (Cameron and Trivedi, 2013). However, the Poisson regression model is often associated with over-dispersion and under-dispersion. A test of dispersion was performed and detected the problem of overdispersion hence the study went for an alternative method given the presence of overdispersion which is Negative Binomial regression model.

The negative binomial regression model is a generalization of the Poisson model which loosens the restrictive assumption that the variance is equal to the mean in the Poisson model. It is therefore assumed that the results from a binomial model will be more precise than estimates from a Poisson model (Martey and Kuwornu, 2021).

Analysis of differences between rural and urban areas in terms of livelihood outcomes' impacts of mobile money.

Two methods were used for this objective. Firstly, the propensity score matching was used to assess the impact of mobile money on households' food consumption and wealth assets.

Secondly, the Oaxaca Blinder decomposition method was used to evaluate the gender and location food consumption and wealth assets gaps among the households sampled as units of analysis of the current study in hand.

Propensity scores matching model specification.

The units of analysis are households defined as *Y* (1) and *Y* (0) for mobile money users and non- users MMOACC, a binary variable being equal to **1** for mobile money user (treatment in this case) and **0** otherwise. The measure of interest is the Average Treatment Effect on the Treated (ATT), which can be expressed as follow:

$$E_{ATT} = E(Y_1 - Y_0)/T = 1)=E(Y_1/T=1)-E(Y_0/T=1) \quad (9)$$

The ATT measures the difference between the expected Wealth Assets Index for mobile money users and non-users, and the same applies for the food security measure indicated by Food Consumption Scores (FCS). While $E(Y_1/T = 1)$ is available, the outcome of the mobile money users' households if they had not received the treatment, $E(Y_0/T = 1)]$, cannot be observed but can be approximated by relying on the conditional independence assumption (CIA), which implies that once we control for observable characteristics, the decision of using mobile money or not can be considered

random (Dehejia & Wahba, 1999). The estimate of the ATT based on the assumption of independence conditional on covariates and can be defined as following:

$$E_{ATT}(x) = E(Y_1/T=1,X=x)-E(Y_0/T=0,X=x) \quad (10)$$

Where X is a vector of exogenous covariates that influences both the outcome of the treatment and the control, but that are unaffected by the treatment which is mobile money usage in our study. The problem in the previous equation can be resolved through matching helps the most likely similar individuals between treatment and control based on propensity in the spirit of Rosenbaum and Rubin argument (1983) Cited by Mushi (2019). This step helps to highlight the difference between the treatment and control group in terms of their outcome's variables, which is wealth assets and food consumption scores in this study.

We then used the Oaxaca Blinder decomposition method to assess respectively gender and location gaps in households' food consumption and wealth assets of the households participating in this research. This step allows to compare the means of outcome variables between two samples of urban households and rural, but also two sub-samples of women headed households and men headed ones. The method was applied to two variables that compose indices that require a specific process of computation.

Food consumption and wealth assets computation approaches

The first outcome variable is Food Consumption Score (FCS). Food consumption scores indicator is one of the commonly used indicators of food security and has been popularized by different stakeholders in food security and vulnerability analysis research (INDDEX (2020).Various researchers adopted it as well in the health and household food security fields (Kennedy et al., 2010; Isaura et al., 2018 and Nyangasa et al., 2019). The food consumption scores represent the dietary diversity and energy contained in the food consumed. It is based on the number of food groups consumed by a household over a given period, usually 7 days recall. The relative nutritional importance of the different groups is set, and the indicator is computed based on the frequency of consumption of each group multiplied with a value of its relative nutritional contribution in terms of energy(WFP, 2009). The following table gives details on how each food group is weighed based on its relative nutritional contribution in the diet on 7days recall basis. The maximum and minimum frequency count of food group consumption is 7 and 0 respectively for each group and this is referred to the Comprehensive Food Security & Vulnerability Analysis Guidelines of the world Food Program. The following table gives details on how to do the computation process.

Table 3: Food item and the computation process of Food consumption scores

Food Item	Food group	Weight(A)	Days eaten in past 7 days(B)	Score A*B
Maize, rice, sorghum, millet, bread and other cereals	Cereals	2		
Cassava, potatoes, and sweet potatoes	Tubers, and root crops	2		
Beans, peas, groundnuts, and cashew nuts	Pulses	3		
Vegetables, relish, and leaves	Vegetables	1		
Fruits	Fruits	1		
Beef, Goat, poultry, pork, eggs, and fish	Meat and Fish	4		
Milk, yoghurt, and other dairy	Milk	4		
Sugar and sugar products	Sugar	0.5		
Oils, fats and butter	Oil	0.5		
composite Index (Food consumption scores)				Σ(A*B)

Referring to the table 3, the outcome variable is the food consumption scores proxying the household food security and can be modeled referring to Phami et al.,(2020).

Let's have Y a continuous variable called food consumption scores (FCS), n the number of each food group (n=8 for the current study), the relationship can be drawn as follow:

$$FCS = \sum_{i=1}^{n} X_i, n = 1{\sim}8, \ with \ \ X_i = W_i F_i \tag{11}$$

Where i represents one group out of the eight food groups consumed in the household X_i, W represents the weight associated with each group of food and F the frequency of the consumption of an item by each group.

This process yields a continuous variable that could be categorized into three different categories according to the relevance and needs of the analysis. However, in the current study, the food consumption scores indicator is kept in continuous form in the assessment of its impact's relationship consecutive to mobile money usage among households.

The second outcome variable is the wealth assets index. Wealth assets index is a measure of the relative wealth of households and the methods has been popular in the health sector research, mainly the Demographic Health Survey (Rustein, 2014) and generalized by the main agencies of the united nations such as World Food Program as well as interested research in the household welfare and development (Howe et al., 2011;Gondwe et al., 2021 and Sumarto et al., 2007) such as education , Child

education or school attainment. This indicator is based on the assets possessed by a household and variable for each asset owned is recoded into binary with 1 if the asset is present and 0 if the asset is absent.

Table 4 shows the list of the main assets that were considered for the current study and served in the principal components analysis leading to creation of the wealth index. The index was computed using principal components analysis which helps in reduction of dimensions and the first component is retained as wealth assets index in reference to Hjelm L. et al., (2016).

Table 4: List of variables used in the wealth assets computation.

Productive Assets	Non-productive assets	Household utilities and other
Has a Hand mill= 1, 0 otherwise	Has a Radio	Type of
Has a Sickle = 1, 0 otherwise	Has a Refrigerator	Water Supply
Has an Axe=1, 0 otherwise	Has TV	Toilet
Has a Hoe =1, 0 otherwise	Has a Motorbike	Walls/house
Has a Plough = 1, otherwise	Has a Phone/cell phone	Roof
	Has a Car	Light source
	Has Boat	Person sleeping per room
		Land ownership
		Livestock ownership

Principal components analysis is a multivariate statistical technique of variables' number reduction in each dataset and lead to a smaller number of dimensions.

It means that from an initial set of n correlated variables, the principle creates uncorrelated indices named components, where each one is linearly weighted combining the initial variables(Vyas & Kumaranayake, 2006). For instance, from a given set of variables ranging from X_1 to X_n, we have the following expressions:

Principal component 1: PCA1 = a11 X1 + a12 X2 + ⋯ + a_{1n} X_n implying hence that

$$PC_m = a_{m1} X_1 + a_{m2} X_2 + \cdots + a_{mn} X_n \quad (12)$$

From the previous equations, we have a_mn1 representing the weight for the mth principal component and the nth variable. The weights for each principal component are obtained from the eigenvectors of the correlation matrix, or the covariance matrix for the standardized data. The variance for each component is provided by the eigenvalue of the corresponding eigenvector and the components are ordered, where the first component (PCA1) explaining the largest possible variation in the data subject to the constraint that the sum of the squared weights is equal to 1. As we move to the second, third component, the lesser is the variation and correlation. It is therefore the first principal component taken as representing the Wealth assets. This outcome variable is a continuous variable and was maintained for the analytical purposes of the current objective(Vyas & Kumaranayake, 2006).

Oaxaca Blinder decomposition method specification

The Oaxaca Blinder decomposition methods (Blinder 1973) was initially used to study labor market outcomes by groups and divide the wages between two groups. The first part is called “explained” is due to group differences in productivity characteristics such as education or work experience and the second one considered as residual part cannot results from such differences in wage determinants(Jann, 2008). Since then, the method has been popularized and applied in various studies to establish causal relationship in counterfactual approach with sometimes its variants. Rahimi & Hashemi Nazari(2021) and Adegbite & Adeoye (2018) respectively applied the method in the assessment of the health inequalities and gender gaps in financial inclusion.

In this study, the Oaxaca-Blinder decomposition was used to assess the food consumption and wealth assets gaps between women and men headed households on one side and between urban and rural households on the other side. Hence the specification of the model for the current study is as follows:

Given the two groups A and B respectively men and women headed household or rural and urban households, and Yi the outcome variable, that are food consumptions scores and wealth assets score and a sets of predictors that are: distance to the nearest financial institution, distance to the mobile money agent, remittances reception, age of the household head, education level of the household head, marital status of the household head, employment status household head, social network membership, household member migration, farm size and household size.

Now the task is to find out how much of the mean outcome difference:

$$R = E(Y_A) - E(Y_A) \tag{13}$$

Where $E(Y)$ denotes the expected value of the food consumption scores and Wealth Index is accounted for gender differences in the predictors. The linear model for such function is

$$Y_e = X_e, B_e + \epsilon, E(\epsilon_e) = 0, e \in \{A, B\} \tag{14}$$

Where X is a vector of the predictors and a constant, B contains the solve parameters and the intercept, and ϵ is the error, the mean outcome difference can hence be expressed as the difference in the liner prediction at the group specific means of the regressors represented by the covariates enumerated above for the case of this study. Such difference is expressed as follows:

$$R = E(Y_A) - E(Y_A) = E(X_A)'^{B_A} - E(X_B)' B_B \tag{15}$$

Given that $E(Y_e) = \mathrm{E}(X'_e B_e + \epsilon_e) = E(X'_e B_e) + E(\epsilon_e) = E(X_e)'B_e$, with $E(B_e) = B_e$) and $E(\epsilon_e) = 0$ according to assumptions.

After rearrangement of the equation above, the final expression will be divided into three components called "three-fold decomposition" where the models: $R = E + C + I$, respectively standing for Endowments, coefficients, and Interaction.

For the third objective, the analysis was conducted with 15 variables from which we have, treatment, which is the mobile money account usage (1 if no mobile money account owned and used and 2 mobile money account is owned and used), two outcome variables that are wealth assets index and food consumption scores and are both continuous.

Additionally, we have thirteen covariates that represent socio-economic characteristics of the household head. Those are the predictors of ownership and usage of mobile money. Summary statistics describing the variables are provided in the table below for the whole 15 variables considered for this analysis. The following Table shows theoretical signs associated with its possible relationship with the outcome variables.

4. Results and discussion

Mobile money policy environment assessment

In this section, we provide findings from mobile money policy environment assessment. Two major sources of information were used: first the documentation of secondary information and secondly the key informant's interview. We basically checked the existence of some policy and regulation governing mobile money system, and the level of implementation.

Status of compliance

The mobile money system in Burundi is governed by legal regulations which clearly describe the process from the general provisions, granting and withdrawal of authorization, payment system offer approval, platform interoperability, supervision and control of institution providing payment services. and information obligations and conditions for execution of payment service operations as indicated in regulation No. 001/2017 of the Central Bank. Although well thought out and defined, the regulation is generic, leaving the mobile money system without specific rules of operation, which has implications for its implementation. There is still a lack of coordination between key players (BRB, ARCT and OBR) in the industry and this causes serious problems and overlaps in their roles and responsibilities. However, there are some ongoing efforts by the Central Bank to correct such overlaps between key players. Among these efforts, we can cite the creation of a special department of payment services, including electronic payments. Both the application of generic policies and the lack of coordination or comprehensive policy framework that govern the mobile money ecosystem have caused serious implication:

Discussion

Governing the mobile money system under the same policies as other payment institutions can have significant consequences on both the supply and demand sides of the financial ecosystem.

On the demand side, the application of generic policies and lack of coordination among key players in the mobile money systems may not only prevent to adequately address the unique characteristics and needs of mobile money services to customers but also create conflicts with other policies. Consequently, consumers are not feeling protected in any case that can happen and require claim between customers and services providers which is the case of failure of SMART mobile Burundi. In fact, It is clearly indicated in the article 38 of the regulation 001/2017 relating to payment services and the activities of payment Institutions entitled "protection of funds of customers of payment institutions' by the central bank how customers funds should be protected in case of insolvency of mobile money service providers and the article 10 of the same regulation state that when the mobile money service provider suspends the activities to providing payment services without reimbursing electronic money in circulation, all its accounts must be blocked as explained in Circular No. 01/EP/19 related to the matrix of sanctions applicable to payment institutions. However, this has never happened when SMART mobile operator failed to keep providing payment services including mobile money services since 2022. Customers (Subscribers and Agents) have never been informed of anything regarding the process of reimbursement and are now in a dead end. Which means the electronic money and recharge cards are no longer valid and holders/customers cannot be reimbursed. Additionally, Article 100 of the recently enacted finance law has introduced a new tax of 1% on the income earned by intermediaries involved in mobile money transfer transactions. While the Central Bank is promoting mobile money to reduce the informal circulation of money this tax could impede the progress of mobile money initiatives. As an immediate consequence, the transfers charges for a range of 10,000 to 19,900 BIF were 800 BIF but increased to 1350 BIF, which is an increase of more than 50%. During our interview with the service provider's agents, we realized that the level of transactions reduced, arguing that people prefer to use cash to avoid the transaction costs. Such situation may act against the efforts towards financial inclusion in Burundi and this corroborates the findings of Ndung'u (2019) who found that the taxation of mobile-based transaction may threaten the level of financial inclusion gains and may encourage people to use cash to avoid taxation.

On the supply side, the lack of coordination or a comprehensive policy framework governing the mobile money ecosystem may lead to various consequences. Firstly, this can result in operational risk factors such as fraud, money laundering, and security vulnerabilities, which in turn affect the industry's capacity to effectively manage and mitigate these risks, potentially exposing consumers and financial institutions to financial crimes and security breaches (Mishchenko et al., 2022; Akomea-Frimpong et al., 2019; Whisker & Lokanan, 2019). Secondly, it may lead to fragmented or inadequate regulatory oversight, potentially resulting in inconsistencies in risk management and compliance standards across different jurisdictions. This, in turn, can hinder the development and implementation of effective governance and risk management practices within the mobile money industry (Leon et al., 2012). This happened in 2023 when the revenue authority office (OBR) announced that all the trust accounts of

sasai fintech which is a commercial name of Ecocash are blocked due to arrears on tax debt of Econet-leo. This led to a panic among users of EcoCash based on what happened to SMART mobile Users. They believed that the company is now failing to provide the mobile money services consequently they started exchanging the electronic money against any offer that comes which led to serious losses on the side of Agents who are providing mobile money services at intermediary level, due to lack of transparency and official announcement explaining what was happening. From the interview with key informants from the Central Bank, we realized that was not involved in such decisions, despite the role the central bank is expected to play in the regulation of mobile money system. Thirdly, this situation may leave the industry vulnerable to systemic risks and operational inefficiencies, thereby limiting its capacity to invest in robust risk management systems, compliance frameworks, and security measures (Carrad et al., 2022).

Tailored policies are then essential to address the specific barriers faced by different demographic groups and to ensure that mobile money services are accessible to all segments of the population.

Level of financial inclusion in study

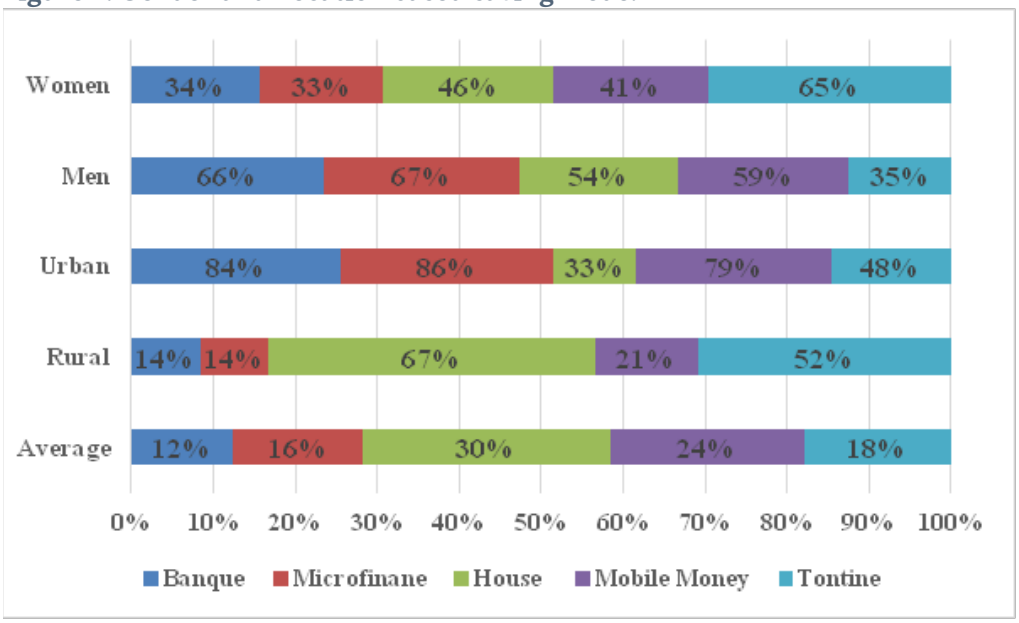
A brief descriptive analysis of the situation of financial inclusion in the area where the survey was conducted was done to for a good understanding. Three indicators were considered to check the level of financial inclusion, namely Banque account ownership, Microfinance account ownership and Mobile money account ownership as indicated in table 5.

It was generally found that the level of use of both bank accounts and microfinance accounts is very low. In fact, it was found that only 32% of respondents own a bank account and most of them are in urban areas (81%). The situation was not different for the case of microfinance account ownership and mobile account ownership where we found that 76 % and 64% of the respondents that respectively use microfinance account and mobile money account are in the urban area, and these location-based differences are statistically significant. However, among the three considered indicators of financial inclusion, only mobile money account ownership dominates in both rural and urban areas. The level of account ownership using all the three indicators is very low among women compared to their counterparts (men), and the bank and mobile money accounts ownership difference were found to be also statistically significant. As expected, it was found that the presence of financial institutions between rural and urban areas is very significant in favor of urban as well as mobile phone ownership. The gender based mobile phone use was found to differ significantly among household led men and women, in favor of men. The difference between the use of mobile money services based on the location was found to be statistically significant and was found to be higher in urban areas compared to rural areas. However, there was no difference between the household led by either men or women regarding the use of mobile money services.

Table 5: Financial Inclusion status around study.

		Overall		Rural		Urban		Chi 2 test	P-Value	Male		Female		Chi 2 test	P-Value
		Yes	No	Yes	No	Yes	No			Yes	No	Yes	No		
Bank Account	Freq	164	352	31	168	133	185	38.92	0,000	111	178	53	175	13.52	0,000
	%	32%	68%	19%	48%	81%	52%			68%	50%	32%	50%		
Microfinance Account	Freq	191	326	45	154	146	172	28.52	0,000	112	177	79	149	0.92	0,3
	%	37%	63%	24%	47%	76%	53%			59%	54%	41%	46%		
Mobile Money Account	Freq	392	125	140	59	252	66	3.4	0.06	235	54	157	71	12	0,001
	%	76%	24%	36%	47%	64%	53%			60%	43%	40%	57%		
ATM	Freq	83	434	10	189	73	245	29.2	0,000	59	230	24	204	9.24	0,002
	%	16%	84%	12%	44%	88%	56%			71%	53%	29%	47%		
Financial Institution in the Area	%	68%	32%	30%	57%	70%	43%	34.3	0,000						
	Freq	353	163%	106	93	247	70								
Mobile Phone	Freq	404	113	147	52	257	61	5.2	0.02	242	47	162	66	10.7	0,001
	%	78%	22%	36%	46%	64%	54%			60%	42%	40%	58%		
Use of Mobile money Services	Freq	396	120%	122	274	274	43	43.25	0,000	225	63	171	57	0.69	0.4
	%	63%	23%	31%	64%	69%	36%			57%	53%	43%	48%		

Figure 2: Gender and Location based saving mode.



The figure (2) shows the different mode of saving used by respondents in study based on their location and Gender. It was found that generally most respondents prefer to keep their money at home (30%) followed by the use of mobile money (24%) and Tontine (18%). A tontine can be defined as rotating savings funds where the savings benefit each of the members according to a pre-established, but revisable, order. It was also realized that the non-bank-based saving modes are the ones preferred compared to banking-based saving modes. The location-based comparison shows that the home-based saving mode is very low in urban areas compared to rural areas, and banking-based saving mode is higher in urban areas compared to rural areas. A gendered-based comparison on the mode of saving shows that majority of men prefer to save their money in Banks and Microfinances while their counterparts (women) prefer Tontine, home, and mobile money as a way of saving their money.

Determinants of Mobile phone ownership and mobile account registration

The results of the logit regression are presented in Table 6. The Log-likelihood value of -and Wald chi-square value indicate a good model fit which implies that the independent variables significantly explain the variation in the dependent variables.

Table 6. Determinants of Mobile phone ownership and Mobile Money Account Ownership

Variable Names	Mobile Phone Ownership	Mobile Money Registration
	Coefficients (Odds Ratio)	Coefficients (Odds Ratio)
Age category		
]30-35]	0.532(0.285)	0.760(0.344)
]35-45]	1.635(0.921)	1.389(0.637)
]45-60]	2.954 (1.779)	1.704(0.832)
]60<	0.438(0.326) *	0.416(0.260)
Location (Rural)	0.627(0.544) *	0.324(0.244) *
Gender of Household Head (Female)	0.387(0.184) **	0.378(0.152) **
Household Head School level		
Primary	9.67(5.565) ***	10.793(5.410) ***
Secondary	14.687(8.518) ***	15.802(7.838) ***
University	19.303 (17.173) ***	14.739(10.410) ***
Electricity (No)	0.021 (0.013) ***	0.074(0.036) ***
Phone recharge when you don't have electricity		
Neighbor (Solar Power)	3.878 (2.927) *	3.556(2.389) *
Batterie (Rechargeable)	2.875(3.208)	1.340(1.273)
Kiosk (Pay)	5.516 (4.874) *	6.306(5.296) **
Solar Power (at home)	6.84 (6.959) ***	6.572(3.912) ***
Main Source of Income		
Public Sector	3.15(1.65) **	1.906(0.853)
Private Sector (Salary)	2.86 (1.124) ***	2.131(0.761) **
Trade (Small Business)	10.5.638 (11.58) **	4.350(4.361)
Connection Between B/M Account and Mob phone (No)	0.771 (0.343)	0.417(0.186) **
Location # Phone recharge when you don't have electricity		
Urban#Neighbor (Solar Power)	1.82(3)	3(4.53)
Urban#Batterie (Rechargeable)	0.5(1.56)	1.28(2/98)
Urban#Kiosk (Pay)	0.1(0.14)	0.13(0.17)
Urban#Solar Power (at home)	0.22(0.25)	0.5(0.51)
Social Network Membership (No)	0.157(0.056) ***	0.17(0.062) ***
Bank/Micro (In the locality) (No)	1.104(0.409)	1.051(0.356) *
Remittances (No)		1.563(0.478) *
Location # Gender of Household Head (Urban # Female)	3.17(0.19)	3.57(2.22) **
Household size		0.939(0.067)
Employed (No)	1.664 (0.591)	1.411(0.460)
Distance (Recharge Phone)	1.007(0.009)	1(0.008)

continued next page

Table 6 Continued

Variable Names	Mobile Phone Ownership	Mobile Money Registration
	Coefficients (Odds Ratio)	Coefficients (Odds Ratio)
Saving Mode		
Microfinance		3.2(2.1)
House		1.12(0.68)
Mobile Banking		7.8 (0.53) ***
Tontine		4.47(0.36) *
Hosmer–Lemeshow chi2(8)	***14.57***	***12.93***
Prob > chi2	***0.0681***	***0.1143***
Pearson chi2(441)	***362.8***	***502.86***
Prob > chi2	***0.9973***	***0.1993***
Log likelihood	***-130.32581***	***-149.15024***
Wald chi2(33)	***116.94***	***122.77***
Prob>chi2	***0.000***	***0.000***

The results indicate that age significantly influences the decision of the household head to own a personal mobile phone. It was found that personal mobile phone ownership is less likely to occur to Household head with age above 60 compared to the base group category [18-30]. The significant differences in the mobile phone ownership may be true since majority of the population is young in Burundi where 65 % of the population is under 25-year-old (Rasmussen et al. 2019). However, this was not the same regarding the decision to register for mobile money account where the age variable was found insignificantly influencing the registration for mobile money account independently to the age category. Some studies (Forenbacher et al., 2019; Schleife, 2010; Middleton et al., 2010; Foliste et al 2012) found a strong association of age and digital adoption and confirmed that the increase in age is negatively associated with the likelihood of adopting new technologies compared to young people, and these results corroborates our findings.

The findings also indicate no significant influence of location on personal mobile phone ownership but with a significant and positive influence on registration by head of Household. This finding corroborate the finding of Forenbacher et al (2019) who found that geographic location have no effect on the probability of owning a personal mobile phone by a household head but also the finding by Srinuan et al 2011 and Salemink et al, 2017 who found that people living in urban areas have easy access to information and different technologies which facilitate the adoption of new technologies which in this case will be the easy access to information regarding mobile money services and functionality.

Gender and Education level of household heads were found to have a strong association with both mobile phone ownership and registration on mobile money accounts. Educational level was found to have a positive and strong association with

the use of mobile phones and registration for mobile money. Our findings corroborate the finding of Akkeren et al (2003) and Rice et al (2003) found that high education level is associated with the use of personal mobile phone; and Meli et al (2022) found that high education level is associated with the adoption and use of mobile money in Cameroun. Furthermore, gender was found to have negative and significant influence on the decision to own a personal mobile phone and open a mobile account, by the household's head, where it was found that households led by women are less likely to own a personal mobile phone compared to male headed household. This finding resonates the finding of Nyamba et al (2019) who found that male headed household are more likely to use mobile phone compared to their counterpart (female). However, the interaction term of geographical location and gender shows no significant influence on mobile phone ownership but has a positive and strong association with the registration to mobile money account. In fact, it was found that women in urban area are more likely to register for mobile money account than men. This is explained by the fact that most of small business requiring very small capital which does not require a bank account, are undertaken by women in majority, in urban area. The marital status of the household head was found to have insignificantly influenced the use of personal mobile phone and register for mobile money.

The lack of electricity to charge a mobile phone for mobile phone holders was found to be negatively and significantly associated with the use of mobile phone and the use of mobile money account by household head. Similar results were found by Armey et al (2016) who found evidence that increasing the availability of electricity within underserved Countries significantly increases the number of digital users; Forenbacher et al (2019) who found that electricity plays a key role in mobile phone ownership in Nigeria; and Alhassan et al (2020) who found a significant association between lack of electricity and non-use of mobile money in rural areas of Africa. However, in our study we have tested four alternative ways of charging mobile in absence of electricity. These were: having small solar power tool, having a neighbor who owns it, having a battery (rechargeable) and having a kiosk in the area where someone can charge for payment. Our study found that having a small solar power or having a neighbor who owns it significantly increases the ownership of a personal mobile phone and register for mobile money. Furthermore, the results reveal that having a kiosk in the neighborhood where phone owners can charge for payment increases the chances of owning both a personal mobile phone and mobile account. The alternatives' ways of recharging didn't have same effect in rural and urban areas, where they were found not significant in urban area compared to rural area in most cases.

Non-membership in social networks was found to have a negative and strong association with the use of mobile phones and mobile money. Membership in social networks is considered as a place where information can easily be exchanged and hence reduces the perceived risk or increases the understanding of the importance of something new hence its adoption. This may be the case with mobile phone ownership and use of mobile money where some may perceive it as expensive to own a mobile

phone or use a mobile money account once out of any social network hence do not adopt. Our finding corroborates the finding of Murendo et al. (2018) who found a positive and significant relationship between social network membership and mobile money adoption and use in Uganda. The saving mode of the household head was also found to have a strong and positive association with the registration of mobile money. Membership of Tontine was found to be positively strongly associated with the use of mobile money. Tontine works in regular contribution by members which require them to keep some money from what they have received for next contributions which require a saving in mobile money account. Using mobile banking which gives the access of one's bank account through his mobile phone was found to have a positive and strong association with the use of mobile money services this is due to the connection that already exist between mobile money service and mobile banking which can facilitate to feed a mobile money account using a bank account.

Determinants of intensity of use of mobile money services

Determinants of mobile phone ownership or mobile money registration may not necessarily be the same as determinants of the intensity of use of mobile money services. The latter is measured by the number of times per week a visited household head used any mobile money service, which was measured using the negative binomial model. The choice of a model is due to the detection of overdispersion which disqualify the use of Poisson regression model as it requires the mean and variance to be equal, as indicated in the results (table 7) of a test of dispersion using stata commands (Fevero, 2020; Dean et al (1989)). We computed the models (Poisson and negative binomial) and compared the coefficient and standard error. The results indicate that Poisson results overestimate coefficients and underestimate standard error. However, the interpretation is based on the negative binomial model results, and the focus is on the statistically significant variables.

Our findings indicate that Household head with age above 60, household led by women and household head with university school level, are less likely to use more mobile money services. Which means compared to other age categories, being in the category of 60 and above, the log count of frequency of use of mobile money services is expected to decrease by 0.98. This finding resonates with the finding of Mbiti et al (2011) who found a negative relationship between age and the frequency of use of mobile money.

Furthermore, the difference in the log count of the frequency of use of mobile money services is expected to be 0.25 units less for female compared to males. This result resonates with the findings of Barooah et al. (2018); and Mbiti et al., (2015). The highest education level was also found to be negatively related to the frequency of use of mobile money services. This may be true because educated people are risk averse, given that most mobile money services are related to some transaction costs, educated people will have rational behavior and reduce the frequency of use of these services and save money.

Table 7: Determinants of the intensity of Use of Mobile Money

Variable names	NEGATIVE BINOMIAL		POISSON	
FUSEMO	**Coefficient**	**std. err.**	**Coefficient**	**std. err.**
Age Category				
]30-35]	-0.1785	0.173	-0.08504	0.057
]35-45]	-0.0043	0.165	-0.14142	0.056
]45-60]	-0.2103	0.189	-0.16434	0.063
]60<	-0.9871848 ***	0.271	-1.111203 ***	0.125
Location (Rural)	0.0888*	0.182	0.09310	0.063
Gender (Female)	-0.2523057 **	0.117	-0.3612747 ***	0.040
Education				
Primary	-0.0346	0.215	0.2150304 ***	0.082
Secondary	-0.3106	0.225	0.01751	0.081
University	-0.4542872 *	0.266	-0.07778	0.090
Marital Status				
Married	-0.0711	0.143	-0.1481174 ***	0.046
Widowed	0.0841	0.248	-0.01921	0.086
Employed (No)	-0.2829777 **	0.118	-0.1913184 ***	0.042
Banque Account Ownership (No)	0.0780	0.143	0.14470	0.047
REMITTNCES (No)	-0.3673658 *	0.192	-0.4002485 ***	0.076
Location # REMITTNCES (Urban#No)	0.1977	0.239	0.2798196 ***	0.089
Outmigration (No)	0.0159	0.112	0.05555	0.040
Social Network Membership (No)	0.1121	0.115	0.0975374**	0.040
Mobile Money Account Ownership (Yes)	0.7899	0.168	0.7452001 ***	0.072
Saving Mode				
Microfinance	-0.3608739*	0.1905216	-0.3528625 ***	0.057
House	-0.439526**	0.1982647	-0.3836839 ***	0.064
Mobile Banking	-0.3330	0.207	-0.3665556 ***	0.065
Tontine	0.6416035 **	0.253	-0.5438926 ***	0.085
Presence of Banque/IMF in the Area (No)	0.1133	0.129	0.0738778 *	0.045
Connection of Mobile Phone and Momo account (No)	0.0395	0.133	0.04092	0.042
Electricity (No)	-0.3240855 **	0.151	-0.3006419 ***	0.057
Recharge Distance	0.0034	0.003	0.0043913 ***	0.001
Household size	-0.0171	0.027	-0.00994	0.009

continued next page

Table 7 Continued

Variable names	NEGATIVE BINOMIAL		POISSON	
FUSEMO	**Coefficient**	**std. err.**	**Coefficient**	**std. err.**
Main Source of Income				
Salary (Public Sector)	0.0252	0.163	0.01010	0.058
Salary (Private Sector)	0.2624207 *	0.142	0.2922861 ***	0.049
Trade	0.0925	0.334	0.2716417 **	0.120
_cons	2.1643	0.396	1.85733	0.145
(1/df) Deviance	1.13		7.15	
(1/df) Pearson	1.44		10.3	
AIC	5.7		9.7539	
BIC	-2454.6680		440.10	
Dispersion test	Coefficient	t-value	p-value	
Uhat	1.3	6.49	0,000	

Unemployed household heads are less likely to increase the use of mobile money services compared to employed people. We found that individuals that are unemployment reduces the log of count of frequency of use of mobile money services by 0.28 units. The inverse relationship of unemployment and frequency of use of mobile money services was also found by Akinyemi et al (2020) and Afawubo et al (2020). However, the effect was not like the main source of income. In fact, respondents that work in private and rely on it as a main source of income, are more likely to use high frequency the mobile money services compared to other categories.

Remittances play an important role in the intensity of use of mobile money services. It was found that the non-use reception of remittances is negatively related with the intensity of use of mobile money services i.e., a unit increase in the reception of remittances increases the log counts of frequency of use of mobile money services by 0.36 units. The positive effect of remittances to the intensity of use of mobile money services was also confirmed in different studies like Munyegera et al (2016) who found a positive and significant impact of mobile money frequency of access by household through remittances, and Scharwatt (2019) who found that remittances increase the frequencies of low-income households to use mobile money services. Furthermore, the households that do not have electricity were found to be less likely to use mobile phones and hence not using mobile money. This finding corroborates the findings of many studies (Alhassan et al (2020); Asravor et al 2020; senso et al, 2013).

Impacts of mobile money usage on households' food consumption and wealth assets

Descriptive analysis

Fifteen variables were used, from which the treatment, which is the mobile money account ownership (0 if no mobile money account owned and 1 mobile money account is owned), two outcome variables that are wealth assets index and food consumption scores and are both continuous were used. Nevertheless, the two outcomes were transformed into categorical variables, respectively into wealth quintiles and food consumption groups for descriptive analytical purposes.

Additionally, we have thirteen covariates that represent socio-economic characteristics of the household head. Those are the predictors of ownership and usage of mobile money. Summary statistics describing the variables are provided in the table below for the whole 15 variables considered for this analysis.

Table 8. Description of the variables.

Variable	Observation	Mean	Std. Dev.	Min	Max
Wealth Index scores	516	-0.007	0.952	-2.04	1.398
Food Consumption Scores	516	52.474	17.313	14.5	101
Distance to a Financial Institution in Kilometer	514	2.376	3.862	0	45
Location/Area of residence	516	1.614341	.4872229	1	2
Distance to a mobile money agent	516	1.178	0.484	1	4
Reception of remittance	516	1.58	0.494	1	2
Gender of the respondent	515	1.441	0.497	1	2
Age of the respondent	516	39.379	12.048	18	85
Education Level of the respondent	516	2.527	0.902	1	4
Marital Status of Head of Household	516	1.945	0.567	1	3
Employment status of household head	516	1.4	0.49	1	2
Social Network Membership	516	1.207	0.406	1	2
Household member Migration status	516	1.562	0.497	1	2
Family Size	516	1.63	1.818	0	25
Household size	516	4.962	2.308	0	14

Role of mobile money on food quality consumption and wealth assets within the households

The psmatch 2 package command was essentially used to compute the scores and matching as well as the psgraph, | (for the graph results of balancing property (see Figure 3) obtained via the command pstest to create scores. The level of significance of 5% was used in this analysis (P-value ≤ 0.05). The prediction of the probabilities associated with the mobile money account ownership was conducted using 12 covariates using logit model. The results of the associated logistic regression are reflected in the following table 9.

Table 9: Logistic regression on mobile money account ownership

Mobile money account usage	Marginal effect	St. Err.
Distance to Nearest Financial Institution	.0004521	.00464
Distance to mobile money agent	.1283647***	.04177
Remittance's reception	.0063257	.03609
Gender of the Household Head	-.0982003***	.03621
Age of the household head	.0000709	.00164
Education Level of Household Head	.1306262***	.02377
Marital status of Household Head	-.0392566	.03958
Employment of household Head	.2810825	.05428
Social Network Membership	.2810825***	.05428
Area of the household location	.059909	.04023
Farm Size	-.0206325*	.01064
Household size	-.009571	.00779
Number of obs = 514		
LR chi2(12) =103.28		
Prob > chi2 = 0.0000		
Pseudo R2 = 0.1826		

With *** p<.01, ** p<.05, * p<.1

The finding in table 9 indicates that mobile money usage is predicted by five covariates among the twelve used in this logistic regression analysis. Gender was found to have a negative relationship with the mobile money usage, meaning that being a woman reduces by 9.8 % the likelihood of using a mobile money. In contrast, social network membership shows a strong and positive influence on mobile money usage where being a social network member will increase the likelihood of using mobile money by 28%. The educational level of the household head revealed a positive and significant influence by an increase of about 13% in the likelihood of using mobile money as the educational level is high. These results are consistent with results by Douanla et al., (2022) that highlight the mobile money adoption and use highly dependent on high levels of education, cell phone ownership and employment status

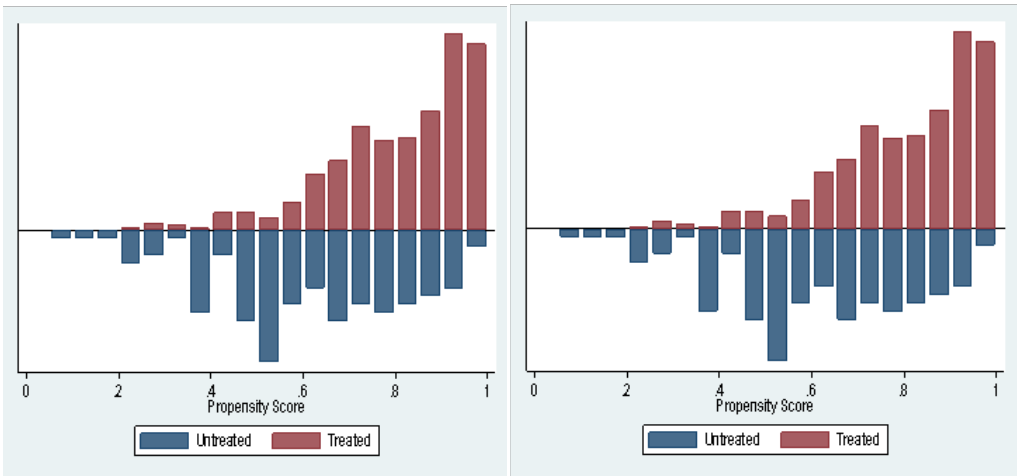
in Cameroon although the employment status of the household was not significant in the present study. The distance to the mobile money agent or provider was revealed to be positive and significantly impacting the usage of mobile whereas the distance declines, the likelihood of using mobile money increases by 12.8%. The preceding finding is consistent with Afawubo et al., (2020) findings showing that belonging to a religious group increased the probability of mobile money adoption process. Such results prove the relevance of social networks that help to reduce information asymmetry through interactions.

On the other hand, variables such area of residence or location, remittances reception, age of the household head as well as distance to the nearest financial institution were revealed to be positively influencing the mobile usage without being significant. In contrast, household size and marital status of the household head was found to be negatively correlated with the mobile money usage without being significant.

Quality assessment for the balancing techniques adopted in the study/for robustness.

Before embarking on the estimation of the treatment effects of the outcome variable (Mobile money usage) on the household's wealth assets and food consumption, we assessed first the quality of the propensity score matching approach. In this research we mainly used two approaches: visual presentation for the distribution of the range of the propensity score matching between the treatment and the control groups under the assumption of the common support and results for the test are present in Figure 3 and table 10.

Figure 3. Graphical representation of the common support for the mobile money account ownership among respondents



Graphically the quality of matching is observed and both treated and untreated appear to be symmetrically distributed in the estimation of the two outcome variables (wealth assets index and the food consumption score) where all observations are symmetrically distributed for both treated and untreated asserting a good quality of balancing. Results in table 10 confirm the conclusion where the all-matched observations in the treatment and control groups fell within the area of common support.

Table 10: Matching assignment of observations by area of the common support

	Psmatch2: Common support		
Psmatch2:Treatment Assignment	**Off support**	**On support**	**Total**
Untreated	0	123	121
Treated	0	391	391
Total	0	514	514

The second approach is based on the reduction of the percentage bias between propensity scores associated with the covariates for both treated and untreated groups where the imbalance is flagged out based on the significance level of the t-test values observed. It is based on the mean difference and key aspects were spotted such as percentage of bias, t-test with p-value as well as the variances ratios with the pstest command and results are presented in table 11.

According to Largoza et al., (2015), strong similarities between controls and treatment groups would be valid when t-values are not significant after matching. In our study, the current results show that only two variables among the 12 covariates were significant with a slight difference.

Furthermore, the variance ratio between the treatment and control group should be close to 1, that is 0.8 and 1.25 according to Rubin D., (2008), and many variables in this study have variances ratios falling within the common support range of 0.82 and 1.22 specific to the current results. However two outliers are flagged out with variables such as Distance to the nearest financial institution(with a variance ratio of 3.73 and p-values of 0.048) for upper boundary, and household size (with a variance ratio of 0.81 and p-values of 0.021) slightly under the down boundary of the common support region(respectively 0.82 and 1.22), but definitely consistent with Rubin D., (2008).

Overall, based on these results, the balancing was judged satisfactory to pursue with the propensity score matching method and the three approaches adopted for balancing property check converge to a slight imbalance but not significant.

Table 11: Standardized differences between treatment and control with balancing property

Variable	Mean		t-test			V(T)/ V(C)
	Treated	Control	%bias	t-test	P-Value	
Distance to the nearest financial institution	2.3049	1.7412	15.4	2.52	0.012	4.99*
Farm Size	1.5217	1.4203	3.9	1.74	0.082	0.94
Distance to mobile money agent	1.2072	1.2176	-2.3	-0.29	0.774	1.15
Remittance's reception	1.6292	1.6794	-10.3	-1.48	0.14	1.07
Household size	4.8772	5.278	-16.6	-2.31	0.021	0.81*
Area of residence (Location)	1.6419	1.7408	-20.1	-3	0.003	1.2
Age of the respondent	38.826	40.229	-11.2	-1.62	0.105	1.08
Gender of the respondent	1.399	1.3542	9.1	1.29	0.197	1.05
Education Level of the respondent	2.7673	2.7101	7.1	1.01	0.312	1.06
Marital Status of the respondent	1.8363	1.84	-0.7	-0.1	0.922	0.85
Employment Status	1.4118	1.4234	-2.3	-0.33	0.742	0.99
Social Network membership	1.2685	1.2119	15.8	1.86	0.064	1.18
Household member migration	1.5934	1.5474	9.2	1.22	0.225	0.97

IV.5. Estimation of the impacts of mobile money on economic status and Food Security

Three matching algorithms based on the propensity score matching variants were applied in computing the average treatment effect on the treated (ATET). The algorithms are kernel Based Matching, Mahalanobis and Nearest neighbor matching.

For an easy view and comparison purpose of the results output from the three algorithms, results are presented in table 12 below and reports ATET, the Stand error and the P-Values for significance of the results associated with each treatment model.

Table 12: Average treatment effects of mobile money on food consumption and wealth assets

Treatment model	Outcome variable	ATET/SE	P-value
Nearest neighbor matching	Wealth Index	0.53780913(0.09861)	0.000
	Food Consumption Scores	10.2500702(1.72309)	0.000
Mahalanobis	Wealth Index	0.60693343(0.19482)	0.003
	Food Consumption Scores	10.3911695(2.60191)	0.000
Kernel based matching	Wealth Index	0.54593233(0.156)	0.000
	Food Consumption Scores	12.1351637(2.648089)	0.000

The results as indicated in table 12 show that the three models used confirm a significant treatment effect on the treated groups on both wealth assets index and food consumption scores. In other words, mobile money usage has a significant impact on the wealth assets and food consumption for its users compared to their counterparts' non-users' households.

Based on the food consumption scores, results show that the ATET is 10.2500702 (p-value = 0.000), 10.3911695 (p-value = 0.000) and 12.1351637 (p-value = 0.000) respectively from the Nearest Neighbor matching method, Mahalanobis method and Kernel based matching. Such results reflect a net positive effect of mobile money usage on the food quality consumption for the households using mobile money against their counterparts' non-users, with an average treatment ranging from 9.15710826 to 11.61228 scores according to method opted for in the ATET estimation. These results corroborate the finding of Murendo et al (2018), who found that the use of mobile money and transfers volumes is associated with a reduction in food insecurity. Similarly, Riley,(2018) and Afawubo et al.,(2020) evidenced the significant importance of mobile money usage in maintaining the level of consumption in Tanzania and positive effect on the ability of responding to naturals shocks such as drought/irregular rain, high prices of agricultural inputs, soils degradation and destruction of crops by animals in transhumance shocks for the households mobile money users respectively in Tanzania and in Togo. Moreover, Munyegera et al (2016) found that mobile money adopters have an increased per capita consumption compared to non-adopters. Additionally, his results reveal a positive and significant influence on the remittances volume which help to mitigate chocks from household food shortages as well as in accessing to required agricultural inputs, although in our study, remittances reception revealed to be positive but not significant.

Based on the wealth assets outcome, the ATET is 0.53 (p-value = 0.000), 0.61 (p-value=0.003) and 0.54(p-value 0.000) respectively for the Nearest neighbor matching method, Mahalanobis matching and kernel-based matching. The present results imply that using any of the three matching techniques, mobile money usage increased between 0.53 and 0.60 on average the wealth assets index compared to households led by non-users of mobile money. Our results fall in the debate of the literature where relationship between mobile money and household welfare has been assessed over recent years. For instance, our results converge with Peprah et al., (2020), found that usage of mobile money positively enhanced the household farm output, welfare and wealth in Ghana. Additionally, similar results are found by Twumasi B. et al; (2021) who found that using mobile money is welfare enhancing measured by per capita expenditure, particularly for poor through the mechanisms of the internal remittances received. In fine, the current results converge with Kilombele, H. et al. (2023) found that farmers using mobile money services have increased their maize productivity and reduced their poverty likelihood.

After the previous assessment, we made a detailed analysis of the impacts of mobile on various groups of users and non-users. In the following section, the assessment led to comparison of mobile impacts by gender and location in terms of wealth and food consumption gaps were depicted.

Gender food consumption and wealth assets gaps assessment using Oaxaca Blinder decomposition method for households using mobile money and non-users' households.

This section assessed the food consumption and wealth assets index gaps between women headed households and their counterparts' men, among the mobile money users and non-users on one hand and on the other hand, the same analysis was conducted to assess the gaps with same variable respect to the location (urban vs rural) of those households.

Recall that for the whole sample, 391(76%) against 123(24%) households were using mobile money. Again, 317 against 199 were urban households. Among the mobile money users (391), 156(40) were women headed while 235(40%) were men headed. Additionally, 140(35%) were rural households and 251(64%) were in urban areas.

The Oaxaca-Blinder decomposition results for the two outcomes variables are presented in table 13 below, that is food consumption scores and wealth assets index respectively by Gender and Location. The table combined the results of each outcome variable within two groups of households. The first group is made of households using mobile money (391 households) and the second group is made of households not using mobile money (123) both containing women headed and male headed households.

Table 13: Gender food consumption gaps for households' mobile users and mobile money non-users in Burundi

Number of Obs = 391		N of Obs =123
N of Obs of Male = 235		N of Obs Male =52
N of Obs of Female = 156		N of Obs Female = 71
	MM users	**MM non-users**
1. Food consumption scores	**Coef.**	**Coef.**
Overall		
Group_1: Male	55.398 (1.145) ***	46.845 (2.054) ***
Group_2: Female	55.485 (1.402) ***	39.88 (1.622) ***
Difference:	-0.087 (1.81)	6.964 (2.617) ***
- Due to Endowments	0.054 (1.363)	3.784 (2.218) *
- Due to Coefficients	0.359 (1.607)	1.86 (3.816)
- Due to Interaction	-0.499 (1.123)	1.321 (3.606)
2. Wealth Index		
Overall		
Group_1: Male	0.145 (0.063) **	-0.378 (0.117) ***
Group_2: Female	0.215 (0.071) **	-0.785 (0.096) ***
Difference:	-0.07 (0.095)	0.407 (0.151) ***
- Do to Endowments	-0.123 (0.076)	0.099 (0.136)
- Due to Coefficients	0.042 (0.07)	0.407 (0.208) **
- Due to Interaction	0.012 (0.055)	-0.1 (0.206)

For Mobile money users, the results in table 13 shows a mean of food consumption scores of 55.398 and 55.485 respectively for men headed households and women headed households, which yield to a gender food consumption gap of 0.087 in favor of women headed households although not significant. The endowments component appears to have a little contribution to the observed gender gap on food consumption within the mobile money users' group with a mean contribution of 0.054 for food consumption scores. It is therefore interesting to point out that the current difference could not be due to the observed characteristics in the study for this specific outcome and groups in question (Households mobile money users).

For the case on non-users of mobile money, the mean estimate is 46.845 and 39.88 respectively for men and women headed households, with a significant difference in food consumption scores of 6.964. For mobile money non-users' households, the results show a significant mean increase in food consumption of about 3.784, and the endowments contribute to about 54% of the observed difference in food consumption between female headed households and male headed households in the household's group of non-users of mobile money.

The above respective results between users and non-users of mobile money show a tremendous role of mobile money in reducing gender-based inequalities in households' welfare through food security (non-significant difference between women headed and men headed households across the mobile money users' group while it is significant in the non-user's group). Food security as well is a short-term variable and food cooking is the matter of women in most of the cases in the Burundian society.

Regarding the results on the wealth assets outcome variable, we observe for the mobile money non-users' on one side, a wealth assets index means of -0.378 and -0.785 respectively for men headed household and women headed households, which yield a significant wealth assets gap of 0.407 in favor of men headed households. Furthermore, it turns out that the endowments components contribute without being statistically significant to about 24% of the gender wealth gap observed between women headed households and their counterparts' men headed households, in the context of this study.

For mobile money users' households, the mean estimate for wealth assets is 0.145 and 0.215 respectively for men and women headed households, leading to a non-significant difference in wealth assets in favor of women headed households. Furthermore, the endowment component contribution in this gender wealth assets gap is about 5% of the entire mean difference which is a slightly minimal contribution. Such results implies that there would be a decrease of 0.07 scores in wealth assets for women headed households if they head the same characteristics as men headed households.

Overall, our findings confirm a similar trend for both Wealth Assets Index and food consumption scores outcomes. Furthermore, a gender-based gaps for the mobile money non-users' households is confirmed with significant differences in favor of men headed households for both wealth assets index and food

consumption scores. These results corroborate the finding of Fawehinmi et al. (2014) cited by Adegbite & Machethe (2020) that attribute implicitly higher food insecurity experienced by female headed households to less access to financial resources and social networks(cooperatives) in comparison of their counterpart's male headed households, hence impeding their capacity of smoothing their consumption.

On the contrary, for the household's mobile money users, such trend was observed but in favor of women-headed households although not significant. These results just lie in the same path as those of Mukong et al. (2021) who found that women headed households financially included through formal banking account experienced higher improvement of wellbeing in comparison to their counterpart's male-headed households and Swamy (2014) stating that financially included female-headed households experience greater poverty reduction than their male headed counterparts(Swamy., 2014).

The additional steps of gaps were assessed respect to the households' location, that is rural households located against the urban households located. The following table 3 and 4 presents results for such assessments.

Table 14: Location food consumption and wealth assets gaps for households' mobile money users and mobile money non-users in Burundi

	Number of Obs =123	**Number of Obs=391**
	N of Obs Rural=58	**N of Obs-Rural = 140**
	N of Obs Urn = 65	**N of Obs Urban = 251**
	MM non-Users	**MM Users**
1. Food Consumption Scores	**Coef.**	**Coef.**
Overall		
Group_1: Rural	38.9 (1.651) ***	43.61 (1.066) ***
Group_2: Urban	46.3 (1.888) ***	62.03 (1.029) ***
Difference:	-7.39 (2.509) ***	-18.43 (1.481)
- Due to Endowments	-6.98 (5.055)	-8.938 (4.134) **
- Due to Coefficients	-2.92 (3.726)	-13.67 (2.066) ***
-Due to Interaction	2.52 (5.875)	4.178 (4.291)
2. Wealth Index	**Coef.**	**Coef.**
Overall		
Group_1: Rural	-1.12 (0.076) ***	-0.629 (0.081) ***
Group_2: Urban	-0.16 (0.095)	0.621 (0.034) ***
Difference:	-0.97 (0.122) ***	-1.25 (0.088) ***
-Due to Endowments	-0.6 (0.222) ***	-0.283 (0.153) *
-Due to Coefficients	-0.48 (0.206) **	-0.93 (0.115) ***
-Due to Interaction	0.12 (0.282)	-0.036 (0.178)

In the light of the findings in table 14, we observe that for the non-users of mobile money on one side, the mean of wealth assets index is -0.629 and 0.621 respectively for rural and urban located households, which lead to a significant wealth assets gap of -1.25.

As indicated in table 14, the wealth assets index indicates a significant gap in rural and urban households. These results imply that if the characteristics of rural households were given to the urban ones, the wealth assets index would be 1.25 higher than it is now, and, hence reflecting an improved economic status. Moreover, results on the endowments show a significant contribution with a mean decrease of 0.283 in wealth assets index mean for urban located households if they had same characteristics as rural households using mobile money.

For non-users of mobile money, the mean estimate is -1.12 and -0.16 respectively for rural and urban located households, leading to a significant difference in wealth assets index of -0.968. This result means that if the characteristics of the households located in rural were given to the urban ones, the wealth assets index would be 0.968 less than it is in the current situation or inversely if the characteristics of household located in urban were applied to the ones located in rural, their wealth assets index would be 0.968 higher than it is now, implying a potential better off based on assets possession.

The endowments seem to contribute significantly to the location wealth assets gap with 0.6 scores implying a mean increase of 60% in wealth assets index for rural households if they had the same characteristics as urban located households.

Based on the food consumption score, it turns out that for the mobile money non-users' households on one side, the mean of food consumption scores is 38.92 and 46.307 respectively for rural and urban located households. This yields a significant food consumption gap of -7.385. These results imply that if the urban households had the characteristics of rural households, their mean food consumption scores would have been 7.385 less than it is now. The endowments component contributes about 90% of the location gap observed in food consumption scores.

For the case of mobile money users, the mean estimate is 43.605 and 62.03 respectively for rural and urban located households, leading to a significant difference in food consumption scores of -18.425. Such results mean that if urban households have had the same characteristics as the rural households located, their food consumption scores would be 18.425 scores less than their current level.

In addition, the endowments contribution into the location in terms of food consumption gaps (rural vs urban) show a significant contribution for the households that are using mobile money with a mean decrease of 8.94. This result implies that if the rural households were assigned with the same characteristics as the urban located one, the mean increase in food consumption for rural households would be 8.94 for users among the mobile money users' households' group which is a contribution of almost 50% in the location food consumption gap observed in this study.

Overall, these results compare rural and urban households' food consumption for both users and non-users of mobile money and reveal a strong location gap in

food consumption scores between the two groups. In fact, the location gap (rural vs urban) for the mobile money users' households is largely higher (food consumption scores of 18.425) while their counterpart's mobile money non-users experienced a relatively small gap (a mean consumption score of 7.385). Such results are in contrast with the finding of Debdulalet al, (2019) who found in the context of China, that financial inclusion varied across urban and rural areas in significantly increasing overall consumption, but with a greater impact for rural households.

In the current study's context, these results mean that beyond mobile money usage, rural households may be affected by other variables not considered in this research. For instance, less knowledge and perception of the benefits of food diversity than their urban counterparts (Fan et al., 2023), which would influence the quality of their food consumption regardless the accessibility or affordability. Moreover, mobile money through remittances and payments was found to strongly influencing risk-sharing in rural areas having low access to banks with frictions on effective risk sharing(Manassa, (2020) while in our study, remittances did not show a significance in the regression results. It is therefore important to nuance the results depending both on the type of outcome variable used to evidence gaps associated with the usage of mobile. Furthermore, the present results are also in contrast with those of Sakyi-Nyarko et al. (2022) , that notes a significant impact of mobile money on the well-being of rural households compared to urban households.

However, the current results converge with findings by Mukong et al. (2021), who examined the impacts of financial inclusion on wellbeing in Namibia and found that having a formal bank account and savings account leads to higher wellbeing in rural households compared to those in urban areas. In fact, having a formal bank account was found to increase the wellbeing score by 20% for rural households, while it was 12% for urban households. However, caution should be exercised, given that although these findings align with the concept of financial inclusion, how it is implemented matter significantly, with a strong possibility of bias towards categories of users of financial services depending on socio-economic characteristics.

5. Conclusions

The present study explored the policies and regulations of Mobile Money in Burundi, the determinants of mobile phone and mobile money usage, as well as the intensity of use of mobile money services by targeted households in 5 provinces of Burundi. Additionally, it assessed the impacts of mobile money usage from gender and location perspectives. The study utilized the mobile money policy assessment tool developed by GSMA, logit, negative binomial model, propensity scores matching model, and Oaxaca Blinder decomposition model.

The study concludes that:

1. Regarding the current mobile money landscape, Burundi has already established foundations for mobile money scalability. However, there is a need for specific mobile money regulations and the creation of a legal platform that brings together all key players in the mobile money system.

2. The decision to own a mobile phone is significantly and positively influenced by the education level of the household head, membership in social networks, access to electricity as well as alternative ways of recharging in case of lack of electricity, and the type of occupation engaged in by the household head as the main source of income. The decision to register on the mobile money platform is significantly and positively influenced by educational status, the type of occupation engaged in by the household head as the main source of income, location, access to electricity and its alternative ways, connection between mobile banking and mobile money services, membership in social networks, remittances, and tontine. The intensity of use of mobile money services is positively and significantly influenced by higher educational level, household employment, the type of occupation engaged in by the household head as the main source of income, remittances, and location.

3. Mobile money usage positively influences the quality of food consumption as well as the economic status proxied by the Wealth Index among mobile money users. No gender gap was found in food consumption for both wealth assets index and food consumption among mobile money users. A significant gender gap was found in both wealth assets index and food consumption scores for mobile money non-users. A location food consumption gap was revealed for both mobile money users and non-users, but with significance skewed to mobile money non-users' households. A gap on location wealth assets was spotted out in favor of urban households for both mobile money users and non-users.

6. Implication of the study findings

1. Lack of electricity was found to be a common significant determinant for mobile phone ownership, mobile money registration, and frequency of use of mobile money services. The most interesting finding is that small solar power can be used as an alternative way in rural areas and can have a positive and significant effect on mobile phone usage and mobile money registration. Strategies that can promote access to small solar power should be considered by competent institutions like the Ministry of Hydraulics, Energy, and Mines in Burundi.

2. Participation in local saving groups like Tontine motivated people to register for mobile money accounts. The recognition of such initiatives by the central bank to make it official and supervise it, can make it more credible and attract further low-income households or establishment of small credit through mobile money can hence register for mobile money usage.

3. Remittances played an important role in both the registration, for mobile money usage and the intensity of use of mobile money services. Furthermore, it was found that being in a rural area negatively influences the use of mobile phones, the registration for mobile money accounts, and the intensity of use. By reducing the costs related to remittance sending or reception, as well as expanding their coverage in rural areas, the mobile money operators can increase access to and use of mobile money in rural areas.

4. Significant gender wealth assets index and food consumption gaps were revealed for the mobile money non-users' households while such gap was doing not exist among for the mobile money users. Promoting mobile money access and utilization with focus on women and women initiatives would reduce gender-based inequalities and hence improving households' welfare.

5. Location gaps associated with the wealth assets index and food consumption score were revealed to be high among households that do not use mobile phones. It was also revealed that mobile money impacts rural households more compared to their counterparts urban. Policy makers should initiate an inclusive strategy allowing the expansion of mobile money usage for the underprivileged with a focus on rural areas. Operators as well should sharpen their inclusion strategy and diversify products, allowing non currently served people to be on board.

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