Determinants of Mobile Money Adoption and Use in Burundi

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***Working Paper* DFSP-TT-001**

AFRICAN ECONOMIC RESEARCH CONSORTIUM
CONSORTIUM POUR LA RECHERCHE ÉCONOMIQUE EN AFRIQUE

Bringing Rigour and Evidence to Economic Policy Making in Africa

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AERC Working Paper DFSP-TT-001
African Economic Research Consortium, Nairobi
August 2024

THIS RESEARCH STUDY was supported by a grant from the African Economic Research Consortium. The findings, opinions and recommendations are those of the author, however, and do not necessarily reflect the views of the Consortium, its individual members or the AERC Secretariat.

Published by: The African Economic Research Consortium
P.O. Box 62882 - City Square
Nairobi 00200, Kenya

Contents

List of tables

List of figures

Abstract

This study examines the factors determining mobile money adoption and use in Burundi. Heckman selection model is applied on a recent household dataset (Integrated household living conditions survey in Burundi, EICV 2019-2020). The estimation results point to different socio-economic factors that drive the adoption and use of mobile money in Burundi. Age category, education level, being a member of savings and loans associations, and household size are the factors determining the likelihood of mobile money adoption in Burundi, while the probability of mobile money use in Burundi seems to be influenced only by education level, place of residence, and the well-being level. Considering this study's findings, the Government of Burundi should implement policies to reduce the gender gap and duality urban-rural. Efforts should also be put on education investment to reduce illiteracy. The Government of Burundi should also continue implementing policies to raise the well-being of the population and social self-sustained groups, and initiatives to increase incomes of the population especially in rural areas should be encouraged. In addition, concerted effort from different stakeholders, mobile network operators and regulators, is also needed. Making payment systems flexible by increasing mobile agents in remote areas would also most likely lead to increased mobile money adoption. We hope that the findings from this study will inform public authorities to take necessary measures to increase mobile money adoption and use in Burundi.

Keywords: *Mobile money; Burundi*

1. Introduction

Existing evidence (see for example, Demurgic-Kunt et al., 2017; Sethi and Acharya, 2018) stresses the importance of financial inclusion for increased economic growth and poverty reduction in Sub-Saharan Africa. Access to affordable finance is crucial for development as it allows investments to happen and production activities to take place even in rural areas, leading to increased production and employment (Sethi and Acharya, 2018). In addition, with access to finance, households can smoothen consumption in the face of shocks (Demurgic-Kunt et al., 2017).

However, the formal banking system rarely reaches the rural areas, and when it does, the cost of services becomes a barrier for low-income households and small businesses (International Finance Corporation, 2018). According to Donovan (2012), lack of access to formal financial services means that the poor and small businesses are limited in their ability to save, repay debts, and manage risks responsibly. And, as he further points out, although the fragility of their situation has led to the development of some informal financial instruments, this does not totally solve the problem. It is therefore imperative to find innovative models that help extend financial services to the financially excluded and the poor. It is for this aim that digital financial services started in 2007 in Africa, through mobile phones, with the introduction of M-Pesa in Kenya, in a bid to try bridging the financial inclusion gap. Following the success of M-Pesa in Kenya, other African countries have followed the good practice of adopting mobile money (M-money) technology. With 1.7 billion individuals estimated globally to have no access to banking services, digital banking through M-money has been providing an opportunity to reach the financially excluded and population in remote regions, where formal financial institutions do not dare to reach. As Donovan (2012) points out, the advantage of M-money is that not only does it extend financial services to the poor, but it is also expected to improve productivity as it increases the efficiency and lowers the cost of transactions, improving security, generating new employment opportunities, and creating a platform on which other businesses can grow.

As in other African countries, M-money technology was also introduced in Burundi although its adoption is still low. Based on the most recent national worldwide dataset on household living conditions (Integrated Household Living Conditions Survey in Burundi, EICV 2019-2020), 11% of the adult population (ages 15+) in Burundi owned a mobile account in 2020 (ISTEEBU, 2021). This is very low compared to other EAC countries such as Kenya where M-money adoption rate is 69% in 2021 (Demirgüç-

Kunt et al., 2022). Moreover, as International Finance Corporation (2022) points out, although M-money uptake has been growing in Burundi, it is yet to translate to financial inclusion. One of the explanations given is that the products offered by the existing operators in the market do not necessarily match the needs of low-income customers from a fragile country such as Burundi. Indeed, Burundi is one of the poorest countries in the world. In 2021, its real gross domestic product (GDP) per capita was one of the lowest at US$ 261, placing Burundi towards the bottom of the low-income category. The poverty headcount is also one of the highest, with 62.8% of the population living below the poverty line of BIF 1580 per day in 2020 (ISTEEBU, 2021). In addition, payment systems are not interoperable in Burundi, which is a missed opportunity for financial inclusion and M-money market development (International Finance Corporation, 2022).

There is therefore need for concerted efforts from different stakeholders to increase M-money adoption and use in Burundi for increased financial inclusion, which is still low. Indeed, based on the existing financial inclusion report, Burundi has one of the lowest levels of financial inclusion in Sub-Saharan Africa, with only 7.1% of the adult population (ages 15+) owning an account at a financial institution in 2014 (Demurgic-Kunt et al., 2014). As in other developing countries, people from rural areas, especially women and the youth, are most affected by financial exclusion in Burundi. Indeed, a recent survey (Banque de la République du Burundi, 2017) revealed some gender and demographic differences in account ownership; the number of women owning an account at a financial institution being almost half the number of men, similarly for young people between the age of 18 and 29 years, in comparison to those aged 30 years and above. The ratio of account holders also varied depending on socio-economic category. The survey pointed to lack of income, inability to save and difficulty in meeting the minimum amount required as the main obstacles to opening an account, and monetary poverty and lack of information as the main obstacles to accessing credit. Indeed, these barriers to financial inclusion can be bridged through adoption of M-money technology, which allows excluded people from the formal financial system to perform financial transactions relatively cheaply, securely, and reliably (Demirgüç-Kunt and Klapper, 2012). However, Burundi being one of the poorest countries in the world, the mobile phone penetration is low, estimated to be 31% for basic and feature phones, and around 25% for smartphones.[1] The level of mobile phone penetration is much lower in remote rural areas. Nonetheless, M-money has a big role to play for increased financial inclusion, since it dominates by far other digital financial services provided by operators in Burundi (International Finance Corporation, 2022).

To suggest ways to increase M-money adoption and use, there is need to study the determinants of mobile money adoption. The question we ask, therefore, is what are the factors driving M-money adoption and use in Burundi? A number of studies have examined the factors affecting M-money adoption and use in some African countries. To name but a few, Amoah et al. (2020) found that age, education and income were among the main determinants of M-money use in Ghana. Akinyemi and Mushunje (2020) found that age, years of education, unemployment, and ownership

of bank accounts explain the adoption of M-money technology in rural areas of Africa. Coulibaly (2021) found that age, gender, the level of education, the level of income, and being employed are the main determinants of M-money adoption in the West African Economic and Monetary Union (WAEMU) and in East Africa.

However, similar studies do not exist for the case of Burundi. Besides, factors depicted elsewhere may not explain M-money adoption and use for the case of Burundi given the specificities of each country. Indeed, Burundi is a fragile country that has suffered multiple cycles of civil conflicts. It is currently among the poorest countries in the world and lagging other EAC countries in terms of most development indicators. A country-specific study is therefore needed.

Using the recent national survey database (Enquête Intégrée sur les Conditions de Vie des Ménages au Burundi, EICVMB 2019-2020), which was collected on 8,490 households, the aim of the proposed study is to analyze the factors affecting M-money adoption and use in Burundi. We hope that the findings from this study will inform public authorities to take necessary measures to increase mobile money adoption and use in Burundi, which is necessary for increased financial inclusion especially in rural areas.

The rest of the paper is organized as follows: section 2 gives an overview of financial inclusion in Burundi; section 3 presents the theoretical framework; section 4 presents the methodology; section 5 presents and discuss the results; and section 6 gives the concluding remarks.

2. Overview of financial inclusion in Burundi

Financial inclusion in Burundi

Data about financial inclusion in Burundi is largely outdated given that the last Findex survey dates to 2014 (Groupe de la Banque Mondiale, 2020). According to the latest financial inclusion survey in Burundi, the proportion of adult population (ages 15+) that owned an account at a financial institution was 7.1% in 2014 (Demurgic-Kunt et al., 2015). This is very low compared to the Sub-Saharan African average of 34% in 2014, and some other countries in the region, such as Kenya and Rwanda, where the rate of account ownership at a financial institution reached 55% and 42%, respectively. Similarly, looking at some other indicators of financial inclusion such as the number of commercial bank branches (per 100,000 adults), number of automated teller machines (ATMs) per 100,000 adults, number of deposits accounts with commercial banks per 1,000 adults, etc., one can notice that the level of financial inclusion is still low in Burundi, in comparison to other countries in the region (Table 1).

In addition, a national financial inclusion survey in Burundi conducted in 2016 (Banque de la République du Burundi) indicated that the number of access points have been increasing but remain highly concentrated within the capital city, Bujumbura. The ATMs are very few and are also concentrated in Bujumbura City. Table 2 highlights some other indicators from that survey.

Table 1: Some indicators of financial inclusion in Burundi in comparison with Kenya and Rwanda

Indicator	Country	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Number of commercial bank branches per 100,000 adults	Burundi	2.5	2.8	3.3	3.2	3.2	3.2	-	-	-	-	-
	Kenya	4.9	5.2	5.3	5.5	5.6	5.4	5.2	5.0	4.8	4.7	4.4
	Rwanda	5.6	5.7	6.1	5.9	6.2	6.3	6.2	5.8	5.3	4.6	3.4
Number of all microfinance institution branches per 100,000 adults	Burundi	0.4	0.5	0.4	0.7	0.7	0.8	-	-	-	-	-
	Kenya	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	Rwanda	1.5	1.4	1.2	1.7	1.8	3.3	2.5	2.5	2.9	2.8	3.0
Number of ATMs per 100,000 adults	Burundi	0.7	1.0	1.6	1.5	1.4	1.4	-	-	-	-	-
	Kenya	9.0	9.4	9.5	9.6	9.7	9.2	9.4	9.2	7.7	7.3	6.9
	Rwanda	2.8	4.7	5.2	5.6	5.6	5.7	5.7	5.2	5.0	4.3	4.2
Number of depositors with commercial banks per 1,000 adults	Burundi	34.5	36.4	28.8	33.1	33.1	-	-	-	-	-	-
	Rwanda	173.3	213.0	216.9	169.8	148.0	191.9	206.6	266.3	261.2	285.5	287.7
Number of deposit accounts with commercial banks per 1,000 adults	Burundi	35.9	42.3	34.7	37.6	40.1	-	-	-	-	-	-
	Kenya	581.0	625.8	831.5	1,048.7	1,255.3	1,425.1	1,584.8	1,785.9	1,939.8	2,119.3	1,944.8
	Rwanda	295.0	338.1	308.8	247.3	202.7	239.9	239.0	398.9	442.4	521.8	621.0

Source: Financial Access Survey Online Database of the International Monetary Fund (IMF)

Table 2: Some financial inclusion indicators for Burundi

Indicators	2012	2013	2014	2015	2016
Number of licensed financial institutions	33	40	42	46	45
Number of access points	492	646	670	768	701
% of access points in urban areas	34.6	38.8	44	44.98	44.94
Number of access points per 1,000 km2	17.7	23.2	24.1	24.4	25.2
Number of access points per 100,000 adults	12.9	14.3	14.2	13.92	13.97
Number of ATMs	27	75	89	109	108
% of ATMs in urban areas	96.3	66.7	94	86.2	87.9
Number of ATMs per 100,000 adults	0.7	1.7	1.9	2.2	2.1
% of adult population living within 8km from the nearest access point	49.4	-	-	-	-
% of the adult population having at least one deposit account in a licensed financial institution	12.5	21.1	21.96	21.92	21.47
Number of accounts (males)	-	503,860	609,797	680,405	529,052
Number of accounts (females)	-	241,850	306,431	359,617	260,262

Source : Banque de la République du Burundi (2017)

The survey indicated that the ratio of account holders was five times higher in urban areas than in rural areas. Moreover, the survey indicated some gender and demographic differences in account ownership. The proportion of men owning an account was almost double the women, while the proportion of young people (aged 18-29 years) owning an account was half of those aged 30 years and older. The ratio of account holders varied depending on socio-economic category; it was 89.5% among state employees, 52.1% for private sector employees, 30.1% for traders and 5.3% for farmers. Contrary to what is observed in many other developing countries, women constitute only 28.3% of microfinance institutions' customers. As observed by Groupe de la Banque Mondiale (2020), this progress has been slow, limited by lack of a strong central leadership for digital transformation, a persistent digital divide between urban and rural areas and lack of coherent strategies on the part of donors. Given the small size of its market (12 million of population on a territory of 27,834 km2), Burundi has potential and would greatly benefit from the implementation of a single digital market in East Africa, which would allow Burundi to integrate a dynamic and deeply integrated pole of investment, innovation and digital trade (Groupe de la Banque Mondiale, 2020).

Overview of mobile money use in Burundi

With the liberalization of the telecom sector in Burundi in 1997, the first mobile network operators started in 1999 but started providing mobile payment services later in 2010. Although few Burundians possess an account in banks, the subscription to mobile payment services, especially mobile money, has been increasing. Until 2021, two mobile money platforms (Sasai Fintech, formerly Ecocash and Lumicash) and 8 mobile banking platforms (Bancobu eNoti, M-cash, Sim Banking, IBB Mobile banking, KCB mobi, Pesaflash, Ecobank mobile, and Rungika) occupied the mobile payment services in Burundi. However, M-money services are the most sought after compared to mobile banking. According to the report by ARCT (2022), at the end of 2017, the number of mobile money subscribers was estimated to be 2.8 million,[2] against only 30,000 in mobile banking. As of the end of the first quarter of 2022, the number of mobile money subscribers has increased to about 5.0 million,[3] although active subscribers are estimated to be only 1.8 million.[4] The number of mobile money transactions has increased from 43,926 in 2011 to 500,000 in 2013,[5] and currently averages 8.3 million.

A number of players are involved in the mobile money ecosystem, including mobile network operators, financial institutions with banking license and infrastructure that enables the exchange of money between different parties, and the regulatory institutions for the financial sector and the communications sector. In Burundi, the regulators are the Central Bank of Burundi and ARCT (*Agence de Régulation et de Contrôle des Télécommunications*). In the M-money ecosystem in Burundi, mobile money service providers partner with five banks: Finbank, Interbank Burundi and KCB Burundi for EcoCash and Lumicash; and National Post Office for EcoCash. The recent national household survey (Integrated Household Living Conditions Survey in Burundi, 2019-2020) indicates that M-money is the most used money transfer channel, with 43%[6] of the sample indicating that they use the channel.

To harmonize its banking policies with those of the East African Community (EAC), Burundi in 2017 adopted new regulations that constrain the telecom companies providing mobile payment services to create new separate and independent entities destined only to that market segment.[7] However, providers of mobile payment services decried the new regulations, saying that they might compel them to increase their service fees.

Digital-driven solutions in the financial sector are yet to fully penetrate the public and private sectors, and government's efforts in that regard would be important. Nonetheless, no roadmap is provided for the development of basic infrastructure and services that support the shift to integrated electronic services for effective financial inclusion. This explains the score of 29.9 out of 100 that the United Nations gave to Burundi relating to E-Government Development Index for 2018 (Groupe de la Banque Mondiale, 2020). The private sector investing in mobile technology is struggling to establish itself over time, with some telecom companies closing after a few years of operation (e.g.. SMART telecom company recently closed), hence limited competition and diversity of services for mobile transactions.

3. Literature review

According to Demirgüç-Kunt and Klapper (2012), barriers to formal account ownership in Africa include, among others, lack of enough money, fixed fees and high costs of opening and maintaining a bank account, and distance from a bank for adults living in rural areas. Poor infrastructure and telecommunications, and heavy branch regulation also restrict the geographical expansion of bank branches. This seems to indicate that while some people are voluntarily financially excluded, most people are involuntarily financially excluded because they cannot afford to use financial services, do not meet the requirements to be eligible or do not have access to it (Cassimon et al., 2022). In any country, other known financial inclusion gaps include the gender gap, disability gap, age gap, religion gap, etc. Recent studies (see for example Demirgüç-Kunt et al., 2018) indicate that M-money, defined as the provision of financial services including payments, finance, and banking, through a mobile device (Donovan, 2012) could promote financial inclusion.

In addition, as Kulkarni and Ghosh (2021) point out, digital financial services such as M-money offer an opportunity to reach the vulnerable groups of society by overcoming obstacles of cost, distance and transparency to meet their financial needs. Indeed, one of the advantages of M-money technology compared to other alternatives is that it is considerably cheaper in terms of transaction costs. McKay and Pickens (2010) found, for instance, that branchless banking (including mobile money) was 19% cheaper on average than alternative services. Moreover, M-money technology provides an opportunity to reach the financially excluded and population in remote regions where formal financial institutions do not want to reach.

With M-money technology, one can send any amount of money to family members in rural areas without needing to pay and trust a courier or take it himself. The digital value is then exchanged for cash at a local agent. The advantage of M-money is that customers are not required to have an account with a financial institution as they transact only through mobile network operators. Furthermore, as Demirgüç-Kunt et al. (2018) point out, the M-money technology can help overcome barriers that prevent unbanked adults from accessing financial services. It could eliminate the need to travel long distances to a financial institution, and lower the cost of providing financial services, hence increase affordability. Moreover, in many low-income countries where micro, small and medium enterprises (MSMEs), representing a large segment of the informal and semi-formal economy, have difficulty in accessing and affording formal financial services, increasing the adoption of mobile money services among these MSMEs could help to bridge the gap.

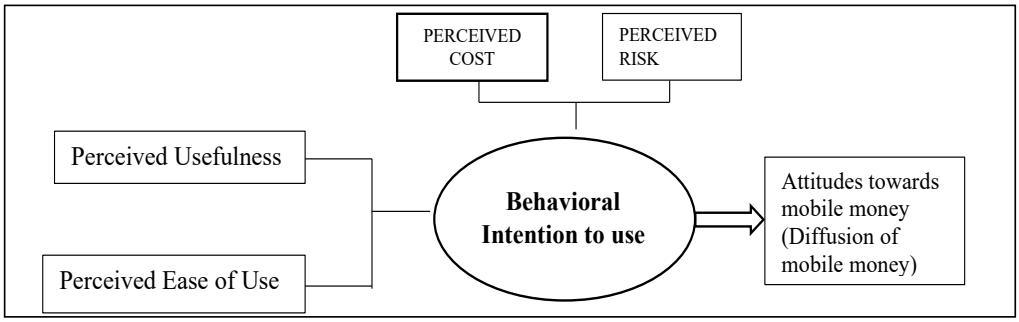
With all the potential it offers to bridge the financial inclusion gap, M-money adoption and use has remained low in some parts of Africa. The existing literature

gives possible explanation to why some people choose to adopt and use M-money technology, while others do not. The diffusion of innovation theory (Rogers, 1995), the technology acceptance model (Davies, 1989), the theory of planned behaviour (Ajzen, 1991) and the unified theory of acceptance and use of technology (Venkatesh et al., 2003) are used in the literature to explain possible consumer behaviour with respect to adoption and use of new technologies and innovations such as mobile money. According to the technology acceptance model, perceived usefulness and perceived ease of use are fundamental determinants of a technology's adoption and use (Davis, 1989). The innovation diffusion theory shows how a social system accepts and begins to use technology. According to Rogers (1995), innovation diffusion depends on factors such as relative advantage, compatibility, complexity, trialability, and observability.

While the prerequisite of mobile money adoption is access (according to Nielsen, 2013), uptake will depend on individual decisions and the quality of service provided. In addition, as Dzokoto et al. (2016) point out, adopting the M-money technology will depend on whether it offers benefits to the alternative ways of payments already in place, after considering the perceived costs and risks. Lesa and Tembo (2016) add that, through the expected benefits and quality of service, the attitude towards mobile money adoption will be shaped by social norms and expected pressures from society. The perceived risk is another factor found in studies, and which affects adoption and use of mobile money services (see for example Suki, 2010). The perceived risk can be thought of as the uncertainty about the outcome of the use of the innovation, i.e., M-money. The perceived cost, which is the extent to which a person believes that using mobile money would cost money (Luarn and Lin, 2005), is another most important factor found in the literature to explain the use of M-money services (Amberg, et al., 2004 and Dahlberg, et al., 2015).

Figure 1 presents the Technology Acceptance Model's conceptual framework. It indicates that it is the perceived costs and risks, combined with perceived usefulness and ease of use of M-money technology that affects its take-up.

Figure 1: Technology acceptance model



Source: Lesa (2016)

Many factors can influence attitudes towards mobile money technology. According to Tobbin and Kuwornu (2011) and Dzokoto et al. (2016), these include, among others, personal aspects such as knowledge, trust, and need; social aspects such as familiarity, norms and pressure; customer's behavioural beliefs about the technology, such as perceived usefulness and the perceived ease of use; and aspects of the technology itself, including the presence of attractive benefits, transaction time, accessibility, simplicity and cost.

Concerning the existing empirical evidence, several studies have investigated the factors determining the adoption and use of mobile money technology. Some of these rely on national survey data (see, for example, Gichuki and Mulu-Mutuku, 2018; Abdul-Rahaman and Abdulai, 2021; Coulibaly, 2021) while others use small-scale own collected survey data (see for example Tobbin and Kuwornu, 2011; Mahfuz et al., 2015; Amoh, 2016). Studies using own-collected survey data usually seek to test the theory behind the technology acceptance model or its modified version, and generally use a structural equation modeling approach. These studies find in general that the perceived ease of use, perceived usefulness, perceived trust, perceived cost of use, and perceived risk are the main determinants of mobile money technology adoption (see Elnaiem, 2019; Abdinoor and Mbamba, 2017; Lema, 2017; Amoh, 2016; Mahfuz et al., 2015; and Tobbin and Kuwornu, 2011). Ntaukira et al. (2021) found that society norms significantly influence continuous intention to use mobile payments in Malawi. In a review of literature on the factors affecting adoption of mobile payments, Dahlberg et al. (2015) highlight the following as the main factors: perceived ease of use, perceived usefulness, trust, risk, demographic factors, security, compatibility, social influence, cost, mobility, convenience, subjective norm, personal innovativeness, habit, privacy, self-efficacy, quality, experience, payment scenario, income, image, knowledge, satisfaction, uncertainty avoidance, technological impulse, complementarity and complexity.

Studies that use national survey data find the drivers of mobile money adoption and use to be among the individual socio-economic and demographic characteristics of the respondents. For example, Fall et al. (2015) conclude that age, education level, membership in savings groups, owning a business, and the wage level are factors affecting mobile banking adoption in Dakar, Senegal. For Kenya, Gichuki and Mulu-Mutuku (2018) find that the level of education, membership to table banking groups, and owning a bank account influence the adoption of M-money services for women entrepreneurs. Similarly for Kenya, Parlasca et al. (2022) found that people are likely to adopt mobile money if nearby agents offer account opening services or if they have received formal training. Other agents' characteristics such as liquidity management and business age were not found to affect mobile money adoption.

Amoah et al. (2020) examined the motivating factors for using mobile money in the Greater Accra Region of Ghana and found that age, education and income were among the main determinants of mobile money use in Ghana. Similarly, Abdul-Rahaman and Abdulai (2021) conclude that the adoption of M-money technology among smallholder

rice farmers in Ghana was significantly influenced by education, farm size, access to credit, membership in farmer-based organizations and location-fixed effects. Asravor et al. (2022) find that age, educational status, marital status, household size, farm size and the type of occupation engaged in by the household head are the main drivers of adoption and use of mobile money technology in rural Ghana.

Akinyemi and Mushunje (2020) analyzed the determinants of M-money technology adoption and use in rural areas of Africa and found that age, years of education, unemployment, and ownership of bank accounts explain both the adoption and use of M-money technology. Nonvide and Alinsato (2022) examined the factors affecting mobile money adoption by smallholder households in Cote d'Ivoire and find that demographic factors (age, gender and marital status), membership in agricultural cooperatives, belonging to savings and credit group, and the level of education, are factors affecting M-money adoption.

Relying on the Global Financial Inclusion Database, Ky (2019) investigated the drivers of M-money adoption in West African Economic and Monetary Union (WAEMU) countries. Using the same database, Coulibaly (2021) compares the drivers of adoption and use of mobile financial services in the WAEMU and in East Africa. Ky (2019) finds that having a bank account, being in the workforce, receiving domestic remittances, owning a mobile phone, and having a national ID explain M-money adoption. Coulibaly (2021) concluded that age, gender, the level of education, the level of income, and being employed were the main determinants of mobile money adoption and use.

4. Methodology and data

Empirical model and its rationale

Mobile money adoption (usage) decision by an individual is assumed to be binary. The individual decides whether to adopt (use) the M-money technology or not. It can be further assumed that an individual makes adoption (usage) decisions by comparing the expected benefits (Y_A^*) from adoption (usage) and the expected benefits (Y_N^*) from non-adoption (usage). Obviously, an individual decides to adopt (use) the M-money technology if the benefits from adoption (use) outweigh the benefits from non-adoption (non-usage), that is:

$$Y_i^* = (Y_A^* - Y_N^*) > 0 \quad (1)$$

where Y_i^* is an unobservable latent variable. We can only observe if an individual adopts (use) the M-money technology (Y_i = 1) or otherwise (Y_i = 0). Y_i^* (the latent outcome) can be expressed as a function of observable characteristics as:

$$Y_i^* = \delta' X_i + u_1, with\ Y_i = 1\ if\ [Y_i^* > 0] \quad (2)$$

Where Y_i = 1 if an individual adopts (use) M-money technology and zero otherwise; δ is a vector of parameters to be estimated; X is a vector of explanatory variables that influence M-money adoption (use) decision; and u_1 is the error term with mean zero and variance σ_1^2. The probability of adopting (using) M-money technology can be specified as:

$$Prob\ (Y_i = 1) = Prob\ (Y_i^* > 0) = Prob(u_1 > -\delta' X_i) = 1 - F(-\delta' X_i) \quad (3)$$

where F is the cumulative distribution function for u_1.

This study uses the Heckman selection (Cameron and Trivedi, 2022; Cook et al., 2021; Greene, 2018; Jones, 2007) to analyze the factors that could explain the M-money adoption and usage for the context of Burundi. The appropriateness of the estimation technique is due to the nature of M-money technology. During EICVMB 2019–2020 data collection, the sequence of questions related to ownership of M-money account and usage of M-money technology were asked to household heads owning mobile

phones. The adoption of M-money technology (here defined as "owning a M-money account") is subject to owning a mobile phone, hence analyzing factors for adoption would entail sample selection bias if we do not consider the fact that individuals will only own a M-money account if they have a mobile phone. Similarly, the usage of M-money (here defined as "performing M-money transactions", i.e., sending or receiving or operating payment of services) is subject to owning a mobile phone. Therefore, we analyse the factors that would explain the usage of M-money for individuals who own a mobile phone.

We estimate equation (2) by assuming the dependent variable (owning a M-money account / usage of M-money) is observed. A selection equation is therefore specified to estimate the probability of owning a mobile phone.

The selection equation is therefore specified as:

$$S_i^* = \gamma' Z_i + u_2 \tag{4}$$

and the probability for selection is specified as:

$$Prob\ (S_i = 1) = Prob\ (S_i^* > 0) = Prob\ (u_2 > -\gamma' Z_i) = \ 1 - F(-\gamma' Z_i) \tag{5}$$

where S_i is the selection propensity variable = 1 if an individual owns a mobile phone; γ is a vector of parameters to be estimated; Z is a vector of explanatory variables that explain the ownership of a mobile phone; and u_2 is the error term with mean zero and variance σ_2^2 .

The two Heckman equations, i.e., the outcome (equation (2)) and the selection propensity (equation (4)) are estimated simultaneously. In general, X is assumed to be a subset of Z, which means that all factors predicting the main outcome of interest (Y) also predict selection S. Results from simultaneous estimation of equations (2) and (4) are interpreted as if we observed the ownership of a M-money account (or the usage of M-money). The focus is on the significance of δ parameters and corresponding marginal effects, but the two ancillary parameters (δ *and* γ) should be explained simultaneously to give a complete sense of the results. It can therefore be assumed that u_1 and u_2 have a correlation, ρ. Heckman estimation approach does not directly estimate ρ, but instead, it constrains it within its valid limits by estimating the inverse hyperbolic tangent of ρ as:

$$\operatorname{atanh}\rho = \frac{1}{2} ln\left(\frac{1+\rho}{1-\rho}\right) \tag{6}$$

The estimated value from equation (6), known as inverse Mills' ratio, is reported along with other results and related transformations and test statistics to allow inferences from both behavioural (or outcome) and selection models.

Data used and variables description

The study used a secondary cross-sectional database from the Integrated Household Survey on Living Conditions in Burundi 2019–2020 (*Enquête Intégrée sur les Conditions de Vie des Ménages au Burundi - EICVMB 2019 - 2020*) conducted by Burundi National Institute of Statistics (*Institut National de la Statistique du Burundi–INSBU*). It is a national level survey database on a sample of 8,490 households (with 5.6 average household size, totalizing 40,073 observations) selected using a multistage sampling process in line with Burundi territory administrative dismemberment. As it was named "Integrated Household Survey", the database is a unified dataset information on household socio-economic characteristics and all themes related to household living conditions, including ownership of a mobile phone and M-money account, and the nature and intensity of M-money transactions. Summary statistics on these household and individual characteristics are presented in Table 4. It is from this integrated database that we extracted data related to attributes that may explain the ownership of M-money accounts and the use of M-money technology (Table 3).

Table 3: Description of variables used for the analysis

Variable	Description	Measurement	Relevant Literature
Dependent Variable			
Mobile money usage	Use of a mobile money technology	A binary variable: 0 = not using mobile money technology; 1 = using mobile money technology	Coulibaly (2021); Meli et al. (2022)
Mobile money adoption	Ownership of a mobile money account	A binary variable: 0 = not owning a mobile money account; 1 = owning a mobile money account	Coulibaly (2021); Meli et al. (2022)
Mobile phone ownership	Ownership of mobile phone	A binary variable: 0 = not owning a mobile phone; 1 = owning a mobile phone	
Independent Variables			
Age of the respondent	Number of years from birth	A continuous variable (number)	Amoah et al. (2020); Akinyemi and Mushunje (2020); Coulibaly (2021); Nonvide and Alinsato (2022)
Place of residence	Place of residence of the respondent	A categorical variable: rural = 0; urban = 1	Meli et al. (2022)
Marital status	Marital status of the respondent	A categorical variable: 0 = single; 1 = married (monogamy); 2 = married (polygamy); 3 = Free union; 4 = widow; 5 = divorced.	Nonvide and Alinsato (2022)
Gender	Gender of the respondent	A categorical variable: female = 0; male = 1	Coulibaly (2021); Nonvide and Alinsato (2022)

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Table 3 Continued

Variable	Description	Measurement	Relevant Literature
Independent Variables			
Education level	Education level of the respondent	A categorical variable: 0 = none; 1 = pre-primary; 2 = primary; 3 = lower secondary; 4 = upper secondary 2; 5 = tertiary	Gichuki and Mulu-Mutuku (2018); Amoah et al. (2020), Akinyemi and Mushunje (2020); Coulibaly (2021); Abdul-Rahaman and Abdulai (2021)
Sector of activity	Respondent's sector of activity	A categorical variable: 0 = Agriculture; 1 = Industry; 2 = Commerce; 3 = Service.	Coulibaly (2021)
Well-being level	Well-being level of the respondent	A categorical variable: 0 = very poor; 1 = poor; 2 = moderately poor; 3 = rich; 4 = very rich.	Meli et al. (2022)
Internet access	Whether the respondent has access to Internet	A categorical variable: 0 = No; 1 = Yes.	
Membership in savings and credit groups	Whether the respondent is a member of a savings and credit group	A categorical variable: 0 = No; 1 = Yes.	Gichuki and Mulu-Mutuku (2018); Nonvide and Alinsato (2022)
Income level	Respondent's income	A continuous variable (Burundian Francs)	Amoah et al. (2020); Coulibaly (2021)

In this study, the adoption of M-money technology is captured by the "ownership of a M-money account". It is a binary variable taking the value of 1 if an individual owned a M-money account and 0 otherwise. From the dataset used, almost 12% owned an M-money account. M-money usage refers to whether one performed or not any activity using M-money technology, i.e., sending or receiving or both or even payment. It is a binary variable taking the value of 1 if the individual sent or received or paid money via M-money technology and 0 otherwise. Almost 15% of individuals in the sample have performed an activity with M-money technology.

According to EICVMB 2019-2020 database, the questions for "ownership of M-money account" (referred to as adoption of mobile money) and "usage of M-money" (referred to as mobile money use) were asked to those owning a mobile phone. The dependent variable for the selection model for both adoption and usage are therefore "owning a mobile phone", taking the value of 1 if the individual owned a mobile phone and 0 otherwise. From the data used in this study, almost 36% of the sample owned a mobile phone.

Table 4: Summary statistics of variables used

Variable	Observations	Summary statistics	
		Mean	Std. Dev.
Usage of a M-money account	21,269	0.147	0.354
Ownership of a M-money account	21,269	0.118	0.323
Ownership of a mobile phone	21,269	0.359	0.480
Age group of the respondent			
15 - 35 years	21,269	0.611	0.488
36 - 60 years	21,269	0.306	0.461
Above 60 years	21,269	0.083	0.286
Place of residence	21,269	0.262	0.440
Marital status	21,269	0.451	0.498
Gender	21,269	0.451	0.498
Education level			
None	21,269	0.344	0.475
Primary	21,269	0.332	0.471
Secondary	21,269	0.267	0.442
Tertiary	21,269	0.057	0.232
Sector of activity	21,269	0.231	0.421
Well-being category	21,269	0.515	0.500
Access to electricity	21,269	0.216	0.411
Membership of savings and credit groups	21,269	0.204	0.403
Household size	21,269	5.609	2.465

Source: Authors' calculations from EICVMB 2019-2020 database

Based on our knowledge of the study area and the empirical literature, we have identified individual and household characteristics that are susceptible of explaining the ownership of a mobile phone, the ownership of M-money account, and the usage of M-money technology. We categorize the age of the individual into 3 groups: i.e. [1]15-35 years; [2] 36-60 years, and [3] 60 years and above, with frequencies of 61.1%, 30.6% and 8.3% respectively. The place of residence is a binary variable with 1 = urban and 0 otherwise, with those living in urban areas accounting for 26.2%. Marital status is a binary variable where 1 = married and 0 otherwise, with those married accounting for 45.1%. Gender is a binary variable where 1 = male and 0 otherwise, with the males accounting for 45.1%.

The level of education is defined as 1 = none (34.4%), 2 = primary (33.2%), 3 = secondary (26.7%) and 4 = tertiary (5.6%). Other binary variables used are the sector of activity (1 = non-agriculture and 0 = agriculture), the well-being category (1 = non-poor and 0 = poor), access to electricity (1 = access and 0 = no access). In the sample study, individuals working in other sectors other than agriculture represent 23.1%, the non-poor are 51.5%, and those with access to electricity are 21.6%. The size of household is also among the explanatory variables (with an average of 5 individuals per household).

5. Results and discussions

The estimation results using Heckman selection estimation technique for the M-money adoption model are presented in Table 5, while those for the M-money usage are in Table 6. For both estimations, the inverse Mills' ratio is statistically significant at 1% level, which implies that the null hypothesis of no selection is rejected. The significance of inverse Mills' ratio indicates the importance of controlling self-selection.

The upper part of Table 5 presents the results of the outcome model (behavioural equation); i.e., the assessment of factors that may explain the ownership of an M-money account for an individual in the sample, given that the individual is selected. The second part of Table 5 presents the estimation results for the selection model; i.e., an assessment of factors that may explain the ownership of a mobile phone, considered as a prerequisite for an individual to own a M-money account. From both models, regression estimates, and marginal effects are presented.

The results from this empirical assessment of the determinants of M-money adoption indicate that age, education level, membership in Saving and Loans Association (SLA), and the household size are the key determinants of M-money adoption in Burundi. However, the results indicate that factors such as gender and place do not explain the likelihood of owning an M-money account.

Most specifically, the estimation results show that moving to a higher age category (i.e., from the category of 15-35 to 36-60 and to 60 years and above) would reduce the likelihood of owning an M-money account by 1.2% and 2.8%, respectively. This finding is in consonance with that of Meli et al. (2022), Amoah et al. (2020), Akinyemi and Mushunje (2020), Coulibaly (2021), Nonvide and Alinsato (2022) and that of Asravor et al. (2022) who also found that age and adoption M-money move in opposite directions for older people. Similarly, Anderson et al. (2017) found that the likelihood of M-money adoption declines with an additional year of age. This finding makes sense since younger individuals are much keener to use the phone and related applications compared to the elderly.

Regarding the level of education, findings show that individuals with tertiary level of education are less likely to adopt M-money technology, with a probability of 2.8% compared to other levels of education. This may be due to the fact that this category of educated people uses mainly financial services offered by formal financial institutions, given their social status. These findings match with those of Gichuki and Mulu-Mutuku (2018), Amoah et al. (2020), Akinyemi and Mushunje (2020), Coulibaly (2021), Abdul-Rahaman and Abdulai (2021), Asravor et al. (2022) where it was found that education level is a key determinant of M-money technology adoption, and for our case, up till to secondary level.

Table 5: Results for mobile money adoption model

Variable	Regression estimates				Marginal effects			
	Coef.	Std. err.	z-stat	P-value	Coef.	Std. err.	z-stat	P-value
Ownership of M-Money Account	**Dependent variable for outcome model**							
Gender (Base group: Female)								
Male	0.016	0.016	1.020	0.306	0.006	0.006	1.020	0.309
Age group (Base group: 15-35 years)								
36-60 years	-0.03**	0.016	-2.100	0.034	-0.012**	0.006	-2.120	0.034
Above 60 years	-0.076***	0.018	-4.200	0.000	-0.028***	0.007	-4.200	0.000
Education (Base group: None educated)								
Primary	0.011	0.019	0.580	0.563	0.004	0.007	0.580	0.564
Secondary	0.013	0.025	0.510	0.610	0.005	0.009	0.510	0.611
Tertiary	-0.075**	0.032	-2.320	0.021	-0.028**	0.012	-2.330	0.020
Place of residence (Base group: Rural)								
Urban	0.024	0.019	1.270	0.205	0.009	0.007	1.260	0.208
Membership in savings and credit groups (Base group: Not member)								
Member	0.079***	0.014	5.530	0.000	0.029***	0.005	5.540	0.000
Household size	-0.007***	0.003	-2.640	0.008	-0.003***	0.001	-2.640	0.008
Owning a phone	Dependent variable for selection model							
Gender (Base group: Female)								
Male	0.576***	0.024	23.800	0.000	0.163***	0.007	23.550	0.000
Age group (Base group: 15-35 years)								
36-60 years	0.345***	0.031	11.140	0.000	0.095***	0.008	11.250	0.000
Above 60 years	0.050	0.034	1.480	0.140	0.013	0.009	1.480	0.140

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Table 5 Continued

Variable	Regression estimates				Marginal effects			
	Coef.	Std. err.	z-stat	P-value	Coef.	Std. err.	z-stat	P-value
Ownership of M-Money Account	**Dependent variable for outcome model**							
Education (Base group: None educated)								
Primary	0.464***	0.027	16.970	0.000	0.131***	0.008	17.010	0.000
Secondary	1.041***	0.039	26.880	0.000	0.321***	0.012	26.000	0.000
Tertiary	1.563***	0.103	15.170	0.000	0.486***	0.030	16.080	0.000
Access to electricity (Base group: No access)								
Access	0.445***	0.049	9.020	0.000	0.133***	0.016	8.380	0.000
Place of residence (Base group: Rural)								
Urban	0.231***	0.046	5.070	0.000	0.066***	0.014	4.820	0.000
Wellbeing category (Base group: Poor)								
Non-Poor	0.327***	0.025	12.860	0.000	0.092***	0.007	12.510	0.000
Main activity (Base group: Agriculture)								
Non-agriculture	0.494***	0.039	12.710	0.000	0.150***	0.013	11.670	0.000
Marital status (Base group: Not married)								
Married	0.245***	0.029	8.560	0.000	0.065***	0.007	8.780	0.000
/athrho	-0.263***	0.052	-5.100	0.000				
/lnsigma	-0.759***	0.012	-63.870	0.000				
rho	-0.257	0.048						
sigma	0.468	0.006						
lambda	-0.120	0.023						

Note: ***, ** and * refer to significance at 1%, 5% and 10% level, respectively

Furthermore, this study reveals that membership of a Savings and Loans Association (SLA) and household size are also significant determinants of the ownership of M-money account. Being a member of SLA would increase the probability of adoption of M-money technology by 2.9%. Nonetheless, the size of households negatively influences the probability of adoption of M-money technology as it reduces the probability of adopting M-mobile money technology by 0.3%. The results concur with that of Coulibaly (2021), Meli et al. (2022), Gichuki and Mulu-Mutuku (2018) and Nonvide and Alinsato (2022) where the relevance of these factors in explaining the adoption of M-money technology was emphasized. This result makes sense given the context of Burundi where households with big number of people may be less financially empowered to engage in transactions that link to M-money technology. This finding contradicts with that of Asravor et al. (2022), where it was found that bigger households engage more in registration for M-money technology.

The results for M-money account usage model are reported in Table 6. The upper part presents the estimation results of the outcome model (behavioural equation); i.e., the assessment of factors that explain the usage of M-money account for an individual in the sample (the extent to which a given individual performs a transaction on his/her M-money account), given that the individual is selected. The bottom part presents estimation results for the selection model; i.e., an assessment of factors that may explain the ownership of a mobile phone. From both models, the regression coefficient estimates, and marginal effects are presented.

The results indicate that the probability of mobile money use is associated with education level, place of residence and well-being category. Specifically, findings of this study indicate that individuals with tertiary level of education are more likely to use M-money transactions compared to those with low level of education. This may be because educated people earn regular income (from their salary) and hence may transact frequently compared to non-employed, specifically given the context of high poverty rate in Burundi. These findings match with those of Gichuki and Mulu-Mutuku (2018), Amoah et al. (2020), Akinyemi and Mushunje (2020), Coulibaly (2021), Abdul-Rahaman and Abdulai (2021), Asravor et al. (2022) where it was found that education level is a key determinant of M-money technology adoption/use.

More specifically, the results show that the probability of M-money use for those aged 36-60 years is 5.8% higher than younger individuals (15-35 years). This result makes sense for the context of Burundi where older people often receive transfers from their relatives to help them smoothen consumption. The same conclusion has been made by findings of Asravor et al. (2022).

The results of this study show that place of residence is an important factor for M-money usage. The probability for M-money use is 2.2% higher for urban people compared to their rural fellows. Similarly, the findings indicate that the probability of M-money use is 2% higher for non-poor individuals compared to poor individuals. The same conclusion has been made by Asravor et al. (2022) in the study in Ghana. This is reasonable given that people in urban centres have more opportunities compared to rural ones, and that a high level of well-being implies having the capacity to invest and engage in more transactions compared to the poor.

Table 6: Results for M-money usage model

Variable	Coef.				Marginal effecfs			
	Coef.	Std. err.	z-stat	P-value	Coef.	Std. err.	z-stat	P-value
Usage of M-money	**Dependent variable for outcome model**							
Gender (Base group: Female)								
Male	-0.028	0.018	-1.510	0.131	-0.010	0.007	-1.540	0.124
Age group (Base group: 15-35 years)								
36-60 years	0.018	0.017	1.070	0.285	0.007	0.006	1.060	0.289
Above 60 years	-0.018	0.018	-0.970	0.334	-0.006	0.007	-0.970	0.333
Education (Base group: None educated)								
Primary	0.018	0.021	0.850	0.394	0.006	0.008	0.840	0.398
Secondary	0.037	0.029	1.270	0.205	0.013	0.011	1.250	0.212
Tertiary	0.069*	0.036	1.900	0.058	0.025*	0.013	1.870	0.062
Place of residence (Base group: Rural)								
Urban	0.062***	0.023	2.720	0.007	0.022***	0.008	2.720	0.006
Access to electricity (Base group: No access)								
Access	-0.001	0.023	-0.050	0.959	-0.000	0.008	-0.050	0.959
Well-being category (Base group: Poor)								
Non-Poor	0.055***	0.018	3.100	0.002	0.020***	0.007	3.020	0.003
Main activity (Base group: Agriculture)								
Non-agriculture	0.035	0.022	1.600	0.109	0.013	0.008	1.580	0.113

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Table 6 Continued

Variable	Coef.				Marginal effecfs			
	Coef.	Std. err.	z-stat	P-value	Coef.	Std. err.	z-stat	P-value
Owning a phone	**Dependent variable for selection model**							
Gender (Base group: Female)								
Male	0.595***	0.025	24.290	0.000	0.167***	0.007	24.080	0.000
Age group (Base group: 15-35 years)								
36-60 years	0.305***	0.031	9.700	0.000	0.083***	0.009	9.770	0.000
Above 60 years	0.021	0.034	0.600	0.548	0.005	0.009	0.600	0.548
Education (Base group: None educated)								
Primary	0.451***	0.028	16.370	0.000	0.126***	0.008	16.390	0.000
Secondary	1.030***	0.039	26.400	0.000	0.315***	0.012	25.500	0.000
Tertiary	1.617***	0.108	14.990	0.000	0.497***	0.031	16.270	0.000
Access to electricity (Base group: No access)								
Access	0.462***	0.050	9.160	0.000	0.065***	0.014	4.720	0.000
Place of residence (Base group: Rural)								
Urban	0.229***	0.046	4.950	0.000	0.137***	0.016	8.500	0.000
Well-being category (Base group: Poor)								
Non-Poor	0.352***	0.027	12.840	0.000	0.098***	0.008	12.490	0.000

continued next page

Table 6 Continued

Variable	Coef.				Marginal effecfs			
	Coef.	Std. err.	z-stat	P-value	Coef.	Std. err.	z-stat	P-value
Owning a phone	**Dependent variable for selection model**							
Main activity (Base group: Agriculture)								
Non-agriculture	0.503***	0.040	12.660	0.000	0.151***	0.013	11.630	0.000
Marital status (Base group: Not married)								
Married	0.230***	0.029	7.970	0.000	0.060***	0.007	8.160	0.000
Membership of savings and credit groups (Base group: Not member)								
Member	0.290***	0.027	10.750	0.000	0.079***	0.008	10.580	0.000
Household size	0.024***	0.005	4.510	0.000	0.006***	0.001	4.520	0.000
/athrho	-0.271***	0.077	-3.530	0.000				
/lnsigma	-0.736***	0.014	-51.330	0.000				
rho	-0.264	0.071						
sigma	0.479	0.007						
lambda	-0.127	0.036						

Note: ***, ** and * refer to 1%, 5% and 10% level of significance, respectively
Source: Authors

6. Conclusion

This study sought to examine the factors determining mobile money adoption and use in Burundi. The Heckman selection model was applied on a recent household dataset (Integrated Household Living Conditions Survey in Burundi, EICV 2019-2020). The estimation results indicated that age category, education level, being a member of savings and loans associations, and household size are the factors determining the likelihood of mobile money adoption in Burundi. However, gender and place of residence were not found to affect the likelihood of mobile money adoption.

Similarly, the results showed that the probability of mobile money use in Burundi seems to be influenced only by education level, place of residence, and the well-being level. Other factors such as gender, age group, access to electricity and the main activity were not found to be significant determinants of mobile money use in Burundi. Considering this study's findings, the Government of Burundi should implement policies to reduce the gender gap by enabling equal female-male adoption and usage of M-money. Efforts should be put in reducing urban-rural and rich-poor gaps in mobile money adoption and use. The Government of Burundi should continue implementing policies to raise the well-being of the population. Initiatives to increase the income of the population, especially in rural areas, should be encouraged. There is a need to improve the population's purchasing power, enabling them to access mobile money technology. In addition, concerted effort from different stakeholders, mobile network operators and regulators, is also needed. For instance, making payment systems accessible in remote areas by increased involvement of agents would most likely lead to increased mobile money adoption. We hope that the findings from this study will inform public authorities to take necessary measures to increase mobile money adoption and use in Burundi.

Notes

1. https://thefintechtimes.com/burundi-fintech-landscape-and-potential-in-the-worlds-poorest-country/

2. https://akeza.net/paiement-mobile-un-marche-domine-par-les-operateurs-de-reseau-mobile/.

3. This is only for Ecocash and Lumicash.

4. https://arct.gov.bi/wp-content/uploads/2022/06/obs1t2022.pdf.

5. Stratégie Nationale d'inclusion Financière (SNIF) 2015-2020.

6. https://burundi-eco.com/transfert-argent-domine-par-mobile-money/#.YygdXtNBzIU.

7. https://www.agenceecofin.com/telecom/0811-51901-burundi-la-banque-centrale-demande-aux-operateurs-de-separer-leurs-activites-telecoms-et-mobile-money.

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