Financial Inclusion through Mobile Money: An Examination of the Decision to use Mobile Money Accounts in WAEMU Countries

Sionfou Seydou Coulibaly

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Financial Inclusion through Mobile Money: An Examination of the Decision to use Mobile Money Accounts in WAEMU Countries

By

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List of abbreviationsand acronyms

- CBWAS Central Bank of West African States
- ROSCAS Rotating Savings and Credit Associations
- UEMOA Union Économique et Monétaire Ouest Africaine
- WAEMU West African Economic and Monetary Union

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Abstract

This study examines whether due to the influence of the penetration of financial intermediaries in WAEMU, the characteristics of individuals who hold mobile money accounts solely are comparable to those of individuals who hold formal bank accounts solely or both types of accounts concurrently. Using the Heckman probit model and the multinomial probit model, the results are similar in regard to those who use formal accounts solely and those who use both types of accounts. The study recommends encouraging intense sensitization of adults aged 25-64 on the use of mobile money, a rise in the levels of individual income, the introduction of incentives in the education system, and greater penetration of mobile payment services.

Key words: Financial inclusion; Mobile money; Financial institutions; Heckman probit model; WAEMU.

JEL Classification: C33, C34, C35, G21, R10.

1. Introduction

Two decades after the discovery and the condemnation of the policy of financial repression, another hindrance to financial intermediation was detected, that of blocking various segments of the population from accessing formal banking services. This inadequacy, termed as "financial exclusion", was, according to Anderloni et al (2008), borrowing from the designation given by Leyshon and Thrift (1993). This appellation was first used by geographers in 1993 while studying the denial of physical access to bank services following the closure of bank branches.

In 2011, the total adult population in the world was estimated at five billion, and 2.5 billion of these adults were holders of bank accounts, whereas 2.5 billion were unbanked. The exclusion of this large number of people from financial services in the world would be explained through impediments such as the high and prohibitive costs of maintaining sufficient numbers of bank branches in unbanked rural areas and the incapacity of the poor to maintain the requisite minimum balance and pay the regular bank charges for standard bank accounts (Aron, 2017).

Nevertheless, due to the contribution to financial inclusion¹ in terms of the fight against poverty and to attain greater and more inclusive growth, the latter has become, since the beginning of the second decade of the 21st century, one of the pillars of the international development agenda (Banque de France, 2014). Consequently, most world economies began integrating actions geared towards reducing financial exclusion in their development strategies. Thus, between 2011 and 2014, 700 million adults became holders of bank accounts, whereas the number of the unbanked dropped by 20% to only two billion. This increase in the level of financial inclusion in the world was possible, according to Demirguc-Kunt et al (2015), thanks to an increase in access to official accounts by 13 percentage points in developing countries and to innovations in the technology sector, particularly in mobile money, which helped to rapidly grow access to formal banking services in sub-Saharan Africa.

With the aim of allowing for a larger segment of the unbanked to access financial services, the mobile phone became more widely used in sub-Saharan Africa as a support for spreading financial services beyond the limits of bank branches. Mobile financial services were first used in Kenya in 2007 through the M-Pesa platform (M for "mobile", Pesa for "money" in Kiswahili) by the Safaricom mobile telephony company.

To improve the level of access to financial services in West African Economic and Monetary Union (WAEMU) countries, the Central Bank (CBWAS²) common to member

states initiated a vast programme of financial inclusion from 1999 that included mobile money as from 2009. However, until 2014, the rate of adults holding a bank account in WAEMU was among the lowest in sub-Saharan Africa. Indeed, in undertaking a comparison between the rate of penetration of bank accounts in WAEMU countries and those of four reference countries in East Africa that had adopted the mobile money platform earlier or at the same time as WAEMU countries, namely, Kenya in 2007, Tanzania in 2008, Uganda in 2009 and Somalia in 2009, a wide gap was observed. In 2014, whereas WAEMU countries represented an average bank account penetration rate of close to 16%, the reference countries represented an average rate of close to 50%. At the same time, the rate of adults with access to a mobile money account was still quite low in WAEMU countries as compared to the four reference countries, or almost 7% for WAEMU against close to 41% for the reference countries. Furthermore, in 2014, out of all the countries of the union, the highest percentage of adults who held a mobile money account was close to 24% in Ivory Coast; or less than a quarter of the people aged 15 and above. Moreover, apart from Ivory Coast and Mali with rates of close to 12%, the other countries in the union represented a rate much lower than 10%. Thus, the statistics demonstrate that despite a steady increase in mobile money in WAEMU from its inception in 2009 to 2014, its adoption was only undertaken by a small segment of the adult population within union countries.

In regard to the low penetration of mobile money accounts in WAEMU countries, an exploration of the determinants of the choice of accounts seems necessary to help increase the level of usage of mobile money. However, given that each financial service goes together with the existence of financial intermediaries, and given that individual choices of financial services could be influenced by the existence of financial intermediaries, examining individual characteristics independently of the penetration of financial intermediaries could carry a bias. Equally, given that mobile money exists in tandem with formal financial services, an examination that isolates the profile of users would not be exhaustive due to ignoring the characteristics of users of formal financial services. Thus, the following questions are raised in this study: Is the use of mobile money accounts determined by characteristics that are specific to individuals and by the penetration of financial intermediaries in WAEMU countries? Are individual characteristics of WAEMU populations that determine the use of mobile money accounts solely different from those of the users of formal financial accounts solely or both types of accounts when the influence of financial intermediaries is taken into account?

The overall objective of this study is to identify, under the influence of the penetration of financial intermediaries, the individual characteristics which determine the use of mobile money accounts in WAEMU as compared to the use of official accounts so as to formulate recommendations for wider financial inclusion. More specifically, the objectives of the study are to 1) identify the social categories that use mobile money accounts as compared to those who only use official bank accounts and to those who would use both types of accounts at the same time; 2) understand the effect of the penetration of financial intermediaries on the use of mobile money accounts only,

compared to the sole use of official bank accounts and that of both types of accounts at the same time; and 3) suggest recommendations that are favourable to increasing the level of usage of mobile money.

To attain the objectives of this study, four hypotheses are empirically tested. The first suggests that a wider use of mobile money services solely is associated with the most vulnerable segments of the population. The second suggests that a wider use of formal services solely is associated with the least vulnerable segments of the population. The third suggests that a wider use of mobile money while still retaining the two types of accounts is associated with the profile of segments of the population that are less vulnerable. The fourth suggests that the use of mobile money services as well as formal financial services is higher with a higher availability of financial intermediaries.

The empirical verification of the hypotheses of this study is derived from a simultaneous estimation of data at the individual level, and of data aggregated with the help of a multi-level approach and through the Heckman (1979) two-step procedure. The results show that whether people use formal financial services or mobile phone-based services, or both, the use of mobile money is higher for men, older people, people within the quintile of the high-income earners, the most highly educated people, and those that have the easiest access to mobile payment agencies.

It is important to note that an examination of the determinants of financial inclusion has inspired several studies in economic literature over the past few years. These studies generally focus on the identification of either individual characteristics or country characteristics linked to the use of formal financial services. However, few studies have attempted to undertake an evaluation of these characteristics combined with the influence of country characteristics. The current study, therefore, brings an empirical contribution to economic research by using a multi-level analysis that allows for the determination of individual characteristics of users of mobile financial services by taking into account the simultaneous influence of the penetration of financial intermediaries. The empirical method used distinguishes this study from those already carried out, in the sense that previous studies only examined individual characteristics (see Klapper and Singer, 2015; Soumaré et al, 2016) or in a manner that separates individual characteristics from aggregated characteristics (see Allen et al, 2016).

The rest of the study is organized as follows: Section 2 presents the literature review, which explains, on the one hand, the place of mobile money as a financial innovation in terms of the achievement of financial inclusion and, on the other hand, a summary of the stylized facts on the evolution of mobile money and formal financial services in WAEMU as compared to some East African countries. Section 3 details the models used to identify the socioeconomic characteristics linked to the use of mobile money services. Section 4 presents the variables and data sources, descriptive analyses of the variables, and the research findings. Section 5 gives the conclusion and the policy recommendations.

2. Literature review

The concept of innovation, placed in an economic context since the foundational studies of Schumpeter, constitutes a key element that draws economic development through a dynamic process by which new technology replaces the old (Tanaka et al, 2005). Besides, in relating innovation to firms, it is suggested that firms innovate in order to improve their performance, by increasing demand or by reducing costs. When it comes to the innovation of processes that lead to productivity gains, the firm benefits from a cost advantage against its competition and obtains a better profit margin. When it comes to product innovation, a firm could obtain a competitive advantage through launching a new product, which would allow it to grow the demand and its profit margin.

The concept of financial innovation, by basing itself on that of innovation in economic methods, is defined as the action of creating and diffusing new financial instruments as well as technologies, institutions and financial markets (Tufano, 2003). This definition is considered by Hunt et al (2009) as a narrow view. Thus, according to Hunt et al (2009), financial innovation covers inventions that allow for new platforms of payment to work. This considers characteristics such as the electronic banking and finance data, electronic communication, and the settlement of transactions and their security solutions. They could also include improvement in existing systems such as improved technologies for automated teller machines and automatic clearing houses or mobile payment. However, according to Gubler (2011), financial innovation should be understood as a process of change, not only in the type and the variety of available financial products, but also change in financial intermediaries and markets themselves. Besides, according to Merton (1995), financial innovations, seen more from the physiological than the pathological point of view, are forces that drive the global system towards its objective of higher economic efficiency. Specifically, innovations that produce by-products could improve effectiveness by expanding the possibilities of risk sharing, reducing transaction costs and also lowering asymmetrical information and agency costs.

Mobile financial services as an innovation that is favourable towards financial inclusion

Because of its higher versatility, the mobile telephone has been used as a tool that simplifies financial services and improve their access to a growing number of the unbanked. The capacity of mobile finances to constitute an instrument which allows

for the integration of a higher number of the unbanked is the subject of several articles in literature. Most of these studies are preoccupied with the question of adoption of mobile financial services (mobile money or mobile banking³).

The detection of factors that are likely to favour an increase in the levels of financial inclusion through mobile banking services has been the focus of research in various analyses. The publication by Siddik et al (2014), by exploring, in the context of Bangladesh, the factors which influence the behavioural intention to adopt (or continue to use) mobile banking services, reveals through Structural Equation Modelling (SEM) that the perceived financial cost, risk and the subjective standard, are key factors. In the same manner, Shaikh and Karjaluoto (2015), by effecting an analysis and a synthesis of existing studies on the adoption of mobile banking, highlight the fact that compatibility (with the lifestyle and the device), the perceived use and attitude are the most important factors of the intention to adopt mobile banking services in developed as well as developing countries. Furthermore, Asfaw (2015), in an attempt to identify the main challenges and opportunities for the development of mobile banking services in Ethiopia, found through a method of exploratory research that an increase in the penetration rate of the mobile telephone was one of the most important prospects for the development of mobile banking services. Equally, Cudjoe et al (2015), through an analysis in the Ghanaian context which specifically focused on clients of "Access Bank," also managed to reveal that awareness, utility, simplicity, compatibility, self-efficacy and the credibility of mobile banking services have a significant effect on the intention of clients to adopt and use mobile banking services provided by "Access Bank". Furthermore, perceived credibility and the financial cost have a stronger effect on the intention by consumers to adopt and use mobile banking services than the perceived utility and ease of use. Using a threestep process that explains the adoption of mobile banking in Senegal, Fall et al (2015), through a sequential logit model, demonstrate that age is the only determinant in the first step. Thereafter, cognitive factors such as literacy, level of education, belonging to a rotating savings and credit association, determine the second step. And in the final step, the level of education, salaries, and business ownership are the factors involved.

An examination of socioeconomic factors that influence the adoption of mobile money services has also been the focus of several studies. By interesting themselves in the socioeconomic aspect of mobile money, Murendo et al (2015) identify the role of social networks in the adoption of mobile money in Uganda. In this regard, they use survey data from 477 rural households and a probit model. The results they obtain suggest that training within social networks contributes to the spread of information on mobile money and improves adoption. Compared to poor households, non-poor households are more dependent on social networks in terms of obtaining information on mobile money. Furthermore, they assume that the adoption of mobile money is likely to be improved if promotion programmes reach networks that are more social.

Because of its numerous benefits, the M-Pesa mobile money system has been adopted at the national level in Kenya, in rural as well as urban zones. On that basis, Gikunda et al (2014) examined the socioeconomic effects of its adoption on the means of subsistence in the sub-county of Bureti in Kenya. Through primary source data, the results of their publication revealed a positive correlation between M-Pesa and job creation, access to credit facilities and the generation of income. In a similar manner, Mbiti and Weil (2011), through an examination of the way M-Pesa is used and its economic impact thanks to individual data on financial access in Kenya, highlight that its increased use reduces the likelihood of people to use formal saving mechanisms such as ROSCAS (rotating savings and credit associations), but increases the probability of their access to banking services. Furthermore, through aggregated data, they show that the speed of M-Pesa is at between 11.0 and 14.6 person to person transfers per month. Equally, M-Pesa causes a drop in the prices of competition in money transfer services such as Western Union. However, inasmuch as there is little proof that people use their M-Pesa accounts as places to keep their savings, M-Pesa improves individual results by promoting banking services and increasing transfers.

Stylized facts on the adoption of mobile money in WAEMU

The operationalization of mobile money services within WAEMU as from 2009 followed the promotion of electronic currency a few years earlier under a CBWAS regulatory framework promulgated in 2006. However, until 2014, as is shown in Figure 1, a large disparity remained between WAEMU member countries in terms of penetration of mobile money accounts. This disparity is highlighted through a variation ranging from 1% in Togo to almost 24% in Ivory Coast. Indeed, in the course of 2014, in all the WAEMU countries, the highest percentage of adults with access to a mobile account was almost 24% in Ivory Coast; in other words, less than a quarter of the people aged 15 and above. Furthermore, apart from Ivory Coast and Mali, which have rates that are higher than 10%, other countries in the union display rates that are below 10%. These statistics show that inasmuch as mobile money has integrated into the financial practices of WAEMU since its launch in 2009, until 2014, its adoption was only the preserve of a small segment of adults in most member countries of the union.

The weakness in the adoption of mobile money in WAEMU is reflected clearly when these statistics from member countries are compared with those from the four reference countries of East Africa that adopted mobile money earlier or at the same time as WAEMU states. The reference countries are Kenya, the pioneer of mobile money in 2007; Tanzania, which adopted in 2008; and Uganda and Somalia, which adopted in 2009. According to the statistics in Figure 1, there is a huge difference between the WAEMU countries and the reference countries that recorded a rapid growth in the use of mobile money. Indeed, whereas no WAEMU member country has reached the level of a quarter of adults with mobile money accounts, the holders of mobile money accounts in Kenya are more than 50% of the adult population. And in Somalia, Tanzania and Uganda, more than a quarter of adults with a mobile money account in WAEMU is on average close to 7% against almost 41% for the reference countries in 2014.

After the implementation of mobile money in 2009 in WAEMU, Figure 2 shows that financial inclusion in terms of penetration of official bank accounts recorded a more or less significant growth in each country of the union over the period 2011-2014. Indeed,

whereas Benin, Niger and Togo recorded increments of between five and eight percentage points, Burkina Faso only registered growth by one percentage point, while Mali and Senegal recorded increments by 12 and 10 points, respectively. Also, in Figure 2, a large disparity is observed between WAEMU countries and reference countries in terms of comparisons between the rates of penetration of official bank accounts. However, in 2014, whereas each of the reference countries recorded a penetration rate higher than that of a third of people aged 15 and above, in all the WAEMU member countries, only Ivory Coast had a rate that is equivalent to a third of adults, or close to 34%. Furthermore, one can observe that in Kenya between 2011 and 2014, the penetration of official accounts increased from a rate of 42% to a rate of 75%. Equally, in Tanzania and Uganda over the same period, the penetration of official accounts increased from a rate of 17% to close to 40% for the former, and from a rate of almost 20% to close to 44% for the latter; or by almost double in each of the two countries. Thus, the use of formal financial services in WAEMU countries compared to our reference, remains slow and weak.

Figure 1: Penetration rate of mobile monet accounts in WAEMU countries and in some East African countries



Note: Representation by the author using data derived from survey data by Global Findex (Global Financial Inclusion Database, 2014).





Note: Representation by the author using data derived from survey data by Global Findex (Global Financial Inclusion Database, 2014).

3. Methodology

Model specification

The exploration of individual characteristics affecting the choice of a financial service suggests that a person can only access that service if he/she subscribes to an account that is linked to it. This condition leads to the testing of a sample selection bias insofar as some individuals in the sample did not respond, or responded that they did not know of the existence of a particular financial service. Given that the individuals that responded yes or no could have different observed and unobserved attributes than the others, including only such individuals in the study could lead to a bias in the selection of the sample according to Heckman (1979). This bias could influence the estimated results. Nevertheless, with choices that function in sequence in that the individual first chooses to subscribe to one financial service or the other before deciding whether to use it, the study model is framed according to the van de Ven and van Praag (1981) specification, which is an extension of that by Heckman (1979) to binary models, both in the selection equation and the result equation. Furthermore, the study retained a multi-level modelling that allows for the combination of survey data and aggregated data taken from other sources (see Kreft and De Leeuw, 1988; Maas and Hox, 2005).

Like the foundational model of sample selection bias of Heckman (1979), in considering a random sample of J observations, the following equations are specified for an individual j of a country i:

A selection equation with, as a dependant variable, the holding of an account represented by, \mathcal{Z}_{ij} , a binary variable that is equal to 1 when an individual holds a given account (mobile money account or formal financial institution account) or both types of accounts at the same time, and 0 if not. The following model is used to investigate the determinants of the dependent variable:

$$z_{ij}^{*} = w_{ij}^{\prime} \alpha + v_{i}^{\prime} \psi + \varepsilon_{ij}, \qquad (1)$$

Where, Z_{ij}^{\star} is the latent measurement of the tendency by an individual to hold an account or both accounts at the same time.

However z_{ii}^* having not been observed, what is observed is:

- $z_{ij} = 1$ if the individual j holds an account or two accounts at a time and $z_{ij}^* > 0$; and $z_{ij} = 0$ otherwise and thus $z_{ij}^* \le 0$.
- w_{ij} and v_i are the vectors of variables of the individual level and the country level, respectively;
- α and ψ represent vectors of estimated parameters;
- $\boldsymbol{\varepsilon}_{ij}$, is a normally distributed error term with an average of zero and a variance that is equal to 1.

Thus, Equation 1 is only applicable to individuals that respond either yes or no to the problem of the possession of one of the accounts or to both at the same time. Thus, it is assumed that individuals that hold an account or the two types of accounts are informed of the possibility of access to a financial account. Thus, it is also admitted that those who do not respond or who do not have knowledge of accounts (mobile money accounts or formal accounts) did not receive any information on the existence of these accounts. This could lead to a problem in the sample selection.

Thus, the decision by individuals to use a financial account is expressed by:

• A substantial equation with, as a dependent variable, the use of an account or two types of accounts represented by, \mathcal{Y}_{ij} , a binary variable equal to 1 when a person who holds an account or two types of accounts uses it/them, and 0 if not. Then, considering the fact that an individual who uses an account or two types of accounts, \mathcal{Y}_{ij} , is conditioned by the fact that he holds this account or these accounts. Thus, the model to use in order to examine the determinants of the dependent variable, \mathcal{Y}_{ij} , is presented as follows:

$$y_{ij}^{*} = x_{ij}^{'}\beta + k_{i}^{'}\gamma + u_{ij}$$
, (2)

Where, \mathcal{Y}_{ij} is a latent variable.

Nevertheless, $y_{ij} = 1$ if the individual j uses an account or two types of accounts, and $y_{ij}^* > 0$; and $y_{ij} = 0$ otherwise and then $y_{ij}^* \le 0$.

 x_{ij} and k_i are the vectors of variables of the individual level and the country level, respectively;

 β and γ represent vectors of estimated parameters;

 u_{ij} is a normally distributed error term, with an average of zero and a variance that is equal to 1.

With (1) and (2), the characterization and the use of an account or of two types of accounts based on individuals who respond by a yes or a no could be written as follows:

$$E(y_{ij}^{*}) = x_{ij}\beta + k_{i}\gamma + E(u_{ij} | w_{ij}\alpha + v_{i}\psi + \varepsilon_{ij}), \qquad (3)$$

$$E(y_{ij}^{*}) = x_{ij}\beta + k_{i}\gamma + E(u_{ij} | \varepsilon_{ij} > -w_{ij}\alpha - v_{i}\psi), \qquad (4)$$

If, \mathcal{E}_{ij} and \mathcal{U}_{ij} are a normal distribution of the zero mean and a variance equal to 1, and if \mathcal{E}_{ij} and \mathcal{U}_{ij} are correlated, Equation 3 could be re-written as:

$$E(y_{ij}^{*}) = x_{ij}\beta + k_{i}\gamma + \rho \left(\frac{\varphi(w_{ij}\alpha + v_{i}\psi)}{\phi(w_{ij}\alpha + v_{i}\psi)}\right),$$
(5)

Where, φ and ϕ are the function of the standard normal density and the cumulative distribution of the normal distribution function, respectively. The ratio of the function of standard normal density on cumulative distribution of the normal distribution function gives the inverse of the recorded mill ratio. This ratio takes into account the selection bias of the sample. Thus, the expected value of the decision to use an account or two types of accounts given that one already holds an account or two types of accounts could be expressed as:

$$E(y_{ij}^*) = x_{ij}\beta + k_i\gamma + \rho\lambda_{ij} , \qquad (6)$$

Thus, the selection bias appears when ρ is not equal to zero, in other words, $E(u_{ii}) \neq 0$.

The analysis of two levels of data (individual and aggregated data) used in the study is inspired by the multi-level approach initially developed in social sciences so as to examine human behaviour by taking into account not only individual characteristics, but also the fact that individuals are part of larger geographic units such as communities and regions (Courgeau and Baccaïni, 1997). Indeed, undertaking an analysis and taking into account only the variables at the individual level would lead to a bias in that the aggregated variables at country level and influence the variation of variables at individual level.

Thus, this study of individual characteristics can only be better understood by making some of the characteristics at the country level abstract. For example, the

appropriation and the use of mobile money accounts at the individual level is strongly influenced by the prevailing characteristics in the country, such as the per capita income level and the availability of mobile payment agencies, etc.

Method of estimation of the model

This study relies upon Heckman (1979) two-step estimation. Indeed, in the first step of this procedure, first a probit estimation is applied to maximize the likelihood of Equation 1 in using all the individuals, including those who did not respond to the questionnaire or who stated that they did not know anything about financial accounts. Then, from an estimation of Equation 1, an estimation of \mathcal{A}_{ij} is obtained. In the second step of the procedure, the estimation of \mathcal{A}_{ij} is integrated as an explanatory variable in the probit estimation of the Equation 2. According to Heckman (1979), this approach eliminates the potential selection bias in the sample. Nevertheless, when \mathcal{A}_{ij} is not statistically significant, there is no selection bias in the sample.

Furthermore, when the selection equation and the result equation include identical explanatory variables, Sartori (2003) states that Heckman's estimator may perform poorly. This is problematic in the context of small samples. For more robust identification, the author suggests to impose an exclusion restriction, which requires that the selection equation includes at least one exogenous variable excluded from the result equation. In this study, a variable related to access to media (the proportion of households with a television set) and intended to inform populations about the existence of accounts (formal or mobile money accounts) is used as exclusion restriction. Indeed, this variable should influence only the decision to hold an account and must not necessarily affect directly the decision to use it.

Analysis of robustness

To support the robustness of the estimations derived from the Heckman selection model, supplementary regressions based on a multinomial model were effected.

General presentation of the multinomial distribution

The multiple-choice models are a generalization of the binary models within which the explained and qualitative variable is thus no longer binary but multinomial or polytomous. In this context, there is only one choice among more than two alternatives. Nevertheless, in terms of the nature of the explained variable, in multinomial models, one examines two classes of choice sets: one ordered and the other non-ordered (Greene, 2012). Various technics were used for the two types of models.

In terms of general presentation of the multinomial model, we consider a random variable, Y_i which could take one among many discreet values that one indicates

1,2,...,*J*. The polytomous variables correspond to the case whereby one observes several modalities in general, be they ordered or not. We assume that a variable y_i could take *J* modalities $y_i \in \{1, 2, ..., J\}$. The probability that the variable y_i could be equal to the modality is written as:

$$p_{ij} = \Pr[y_i = j], \tag{7}$$

Where the probabilities verify for each individual:

$$\sum_{j=1}^{J} p_{ij} = 1, \qquad \forall_i, \qquad (8)$$

We also define the J following dummy variables for each individual:

$$d_{ij} = 1$$
 if $y_i = j$ and $d_{ij} = 0$ if not, with $j = 1, 2, ..., J$

These variables verify
$$\sum_{j=1}^{J} d_{ij} = 1, \forall_i,$$
 (9)

The log-likelihood of a sample ($y_1, ..., y_N$) is thus simply written as:

$$l = \sum_{i=1}^{N} \sum_{j=1}^{J} d_{ij} \ln p_{ij} , \qquad (10)$$

The main characteristic of Models of Ordered Qualitative Responses is that all the options depend upon a unique indicative function. This makes sense when the responses have a natural order, but not otherwise. A different type of model is obviously needed to tackle non-ordered responses. The simplest method is that of using a multinomial logit model, which is mostly used in applied studies. A method that is relatively close to this, known as the conditional logit model, is also widely used. However, a problem with the multinomial logit model and the conditional logit model is that they are based on the hypothesis of Independence from Irrelevant Alternatives (IIA). According to Gujarati (2011), we understand Independence from Irrelevant Alternatives to mean that the error terms, in estimating π_{ij} , the probability of choice for the individual i for the alternative j, is independent of the error term, in estimating π_{ik} , the probability of choice for individual i for alternative k and $k \neq j$.

Various tests of the IIA hypothesis were developed, like the McFadden, Train and Tye test, Small, Hsiao test, and the Hausman and McFadden test. However, after a certain number of simulations with these different tests, Cheng and Long (2007) stated that they were not satisfactory for applied studies. An alternative for relaxing the IIA hypothesis therefore involves allowing the correlation between alternatives of choice or among the error terms. In that case, natural alternatives to multinomial logit models could be the nested logit model, and the multinomial probit model (See Greene, 2012).

Given the non-ordered nature of options in play in this study, the analysis of robustness uses the multinomial probit, which allows for a correlation between the error terms to the detriment of the nested multinomial logit that allows for a correlation between alternatives of choice.

The implementation of a multinomial probit model is justified in this study, in that access to finance is not simply a binary choice, but also gives the possibility to an individual to choose from a totality of more than two modes of financial services: formal finance solely, mobile money solely and both models at the same time. Equally, the choice of each of the different modes of financial services offers the individual the choice between more than two alternative financial operations. For example, the choice of mobile money gives a choice between the alternatives of sending of funds through mobile money, the receiving of funds through mobile money and the payment of public utility bills though mobile money. Whereas the choice of formal finance offers alternatives for savings, borrowing and withdrawals.

Presentation of the multinomial probit model

The multinomial probit model is used with discreet dependent variables which take more than two results that are not in a natural order. The stochastic error terms for this model implementation are assumed to have independent normal distribution standards.

As shown by Greene (2012), structural equations of a multinomial probit model (MNPM) are:

$$U_{ij} = \mathbf{x}_{ij}^{'}\boldsymbol{\beta} + \boldsymbol{\varepsilon}_{ij}, \ j = 1, ..., J, \left[\boldsymbol{\varepsilon}_{i1}, \boldsymbol{\varepsilon}_{i2}, ..., \boldsymbol{\varepsilon}_{iJ}\right] \Box \ N[0, \Sigma],$$
(11)

The term in the log-likelihood which corresponds to the choice of the alternative q is:

$$\operatorname{Pr}ob\left[choix_{iq}\right] = \operatorname{Pr}ob\left[U_{iq} > U_{ij}, \ j = 1, \dots, J, \ j \neq q\right],$$
(12)

The probability of this event is:

$$\operatorname{Pr}ob\left[\operatorname{choix}_{iq}\right] = \operatorname{Pr}ob\left[\varepsilon_{i1} - \varepsilon_{iq} < (x_{iq} - x_{i1})'\beta, \dots, \varepsilon_{iJ} - \varepsilon_{iq} < (x_{iq} - x_{iJ})'\beta\right], (13)$$

for the J-1 other choice, which is a cumulative probability from a (J-1) – var *iate* normal distribution. Because we have undertaken comparisons, one of the variances in this J-1 structure variable, in other words, one of the diagonal elements in the reduced Σ should be standardized to 1.0. Because only comparisons can always be observed in this model, for identification, J-1 the co-variances should also be standardized to zero.

4. Variables, data and research findings

Using data from the Global Financial Inclusion (Global Findex) 2014 survey, this study has designed variables on the use of formal accounts and mobile money in seven WAEMU countries that benefitted from that survey. However, as with the studies by Allen et al (2016), Soumaré et al (2016) and Klapper and Singer (2015), this study maintains, in terms of explanatory variables, the socioeconomic characteristics of individuals by admitting that they could be significant factors in determining access to various financial services (formal or mobile money). Besides, to be in step with the hypothesis of the possible influence of aggregated factors at the country level on the variation of individual variables, the study has retained the variables that are inherent to geographic and demographic penetration of financial intermediaries. These two groups of variables are shown in Table 1.

Variable	Definition	Source
Formal and mobile accounts	A variable that takes the value of 1 if the individual holds an account in a formal financial institution as well as a mobile money account, and 0 if not	Designed by the author using data from Global Findex 2014
Formal account	A variable that takes the value of 1 if the individual holds an account in a formal financial institution account solely, and 0 if not	Global Findex 2014
Savings	A variable that takes the value of 1 if the individual holds an account in a formal financial institution and has saved in the previous 12 months, and 0 if not	Global Findex 2014
Borrowing	A binary variable that takes the value of 1 if the individual holds an account in a formal financial institution and has borrowed through that account in the previous 12 months, and 0 if not	Global Findex 2014
Withdrawals	A binary variable that takes the value of 1 if the individual holds an account in a formal financial institution and has effected at least three withdrawal transactions on the account in a given month, and 0 if not	Global Findex 2014
Mobile account	A binary variable that takes the value of 1 if the individual holds a mobile money account solely, and 0 if not	Global Findex 2014

Table 1:	A presentation	of the variables	and the data sources
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Variable	Definition	Source
Sending	A binary variable that takes the value of 1 if the individual uses his mobile money account to send money, and 0 if not	Global Findex 2014
Receiving	A binary variable that takes the value of 1 if the individual uses his mobile money account to receive money, and 0 if not	Global Findex 2014
Payment	A binary variable that takes the value of 1 if the individual uses his mobile money account to make payments, and 0 if not	Global Findex 2014
Female	A binary variable that indicates whether the respondent is female	Global Findex 2014
Age	Age of the respondent in years	Global Findex 2014
(Age) ²	Age of the respondent squared	Global Findex 2014
Education: Primary	A binary variable that takes the value of 1 if the respondent has completed at least the primary cycle, and 0 otherwise	Global Findex 2014
Education: Secondary	A binary variable that takes the value of 1 if the respondent has completed the secondary cycle and a higher level, and 0 otherwise	Global Findex 2014
Education: Tertiary	A binary variable which takes the value of 1 if the respondent has completed four years of education beyond high school or a college diploma that takes four years to complete, and 0 otherwise	Global Findex 2014
Income: The top 20%	A binary variable that takes the value of 1 if the respondent is found in the highest income quintile, and 0 otherwise	Global Findex 2014
Income: Fourth 20%	A binary variable that takes the value of 1 if the respondent is found in the second quintile of highest income, and 0 otherwise	Global Findex 2014
Income: Intermediary 20%	A binary variable that takes the value of 1 if the respondent is found in the intermediary income quintile, and 0 otherwise	Global Findex 2014
Income: 20% second most poor	A binary variable that takes the value of 1 if the respondent is found in the second income quintile, and 0 otherwise	Global Findex 2014
Income: 20% poorest	A binary variable that takes the value of 1 if the respondent is found in the lowest income quintile, and 0 otherwise	Global Findex 2014

Table 1 Continued

Table 1 Continued

Variable	Definition	Source
Financial freedom index	A score rated from 0 to 100. With 0: repressive situation; 10: near repressive situation; 20: heavy government interference; 30: extensive government interference; 40: strong government interference; 50: considerable government interference; 60: significant government interference; 70: limited government interference; 80: nominal government interference; 90: minimal government interference; 100: negligible government interference.	Heritage foundation database (2014)
Television (% of households)	Percentage of households with a television set in the total population.	World Development Indicators (2013)
Mobile money agencies	The number of mobile payment agencies per 100 000 adults	Financial Access Survey
Micro-finance Institutions	The number of micro-finance institutional branches spread throughout the country	Financial Access Survey
Bank branches	The number of bank branches per 100,000 adults	Financial Access Survey

Source: Representations by the author.

A summary of the statistics of variables

Tables 2 and 3 give the various statistics for the variables of the study.

Variables at the individu	ual level				
Variable	Observation	Mean	Standard deviation	Minimum	Maximum
Formal and mobile accounts	7008	0.0352	0.1844	0	1
Formal account	7008	0.1754	0.3803	0	1
Savings	6953	0.0912	0.2879	0	1
Borrowing	6957	0.0476	0.2129	0	1
Withdrawals	824	0.1626	0.3692	0	1
Mobile account	7008	0.0888	0.2844	0	1
Sending	1714	0.2293	0.4205	0	1
Receiving	2437	0.1670	0.3731	0	1
Payment	1190	0.0824	0.2750	0	1
Female	7008	0.4548	0.4980	0	1
Age	7004	33.9556	15.0572	15	96
(Age) ²	7004	1379.6680	1272.4320	225	9216

Table 2: A summary of the descriptive statistics of variables

Variables at the individ	ual level				
Variable	Observation	Mean	Standard deviation	Minimum	Maximum
Education: Primary	6999	0.6831	0.4653	0	1
Education: Secondary	6999	0.2992	0.4579	0	1
Education: Tertiary	6999	0.0177	0.1319	0	1
Income: The top 20%	7008	0.2838	0.4509	0	1
Income: Fourth 20%	7008	0.2102	0.4075	0	1
Income: Intermediary 20%	7008	0.1771	0.3818	0	1
Income: Second 20%	7008	0.1702	0.3759	0	1
Income: 20% poorest	7008	0.1587	0.3654	0	1
Variables of the aggreg	ated level				
Variable	Observations	Mean	Standard deviation	Minimum	Maximum
Television (% of households)	7	29.8345	15.5761	10	62
Financial freedom index	7	41.4286	6.9007	30	50
Mobile money agencies	7	135.2867	95.6938	19.3828	285.9925
Micro-finance institutions	7	582.8208	310.0157	176	1147
Bank branches	7	3.8481	1.3954	1.4770	5.5447

Table 2 Continued

Source: Calculations by the author.

The descriptive statistics given in Table 2 show that on average in WAEMU, close to 18% of people aged 15 and above hold an account in a financial institution solely, while 9% are holders of a mobile money account solely. However, almost 4% of these adults are holders of both a mobile money account and an account in a formal financial institution.

On the totality of holders of mobile money accounts, on average, close to 23% use them to send money and close to 17% receive funds through their accounts, whereas only 8% use them for payment of public utility bills.

In regard to holders of formal accounts, it is observed that whereas 9% save, only close to 5% borrow, while 16% effect at least three monthly withdrawals from their accounts.

In conclusion, the varied statistics make it clear that in WAEMU a much larger number of subscribers to mobile money services use them contrary to the number of subscribers to official accounts.

Nature of ownership o	faccounts	Formal and mobile money accounts	Formal account solely	Mobile money account solely
Ownership of account	Yes	3.5200%	17.5400%	8.8800%
	No	96.4800%	82.4600%	91.1200%
Gender of respondent	Male	66.4000%	65.3400%	64.1500%
	Female	33.6000%	34.6600%	35.8500%
	Primary	33.6000%	39.7900%	49.2700%
Level of education of	Secondary	55.8700%	52.7300%	44.9100%
the respondent	Tertiary	10.5300%	7.4900%	5.8200%
	20% richest	53.8500%	54.0300%	36.9800%
	20% fourth quintile	21.4600%	19.8500%	23.9500%
Income quintile	20% Intermediary	13.7700%	11.7200%	16.0800%
	Income: 20% second most poor	6.0700 %	7.6500%	10.9300%
	20% poorer	4.8600%	6.7500%	12.0600%
	15-24	4.8600%	3.9900%	7.4000%
Age of respondent	25-64	93.5200%	92.8300%	90.6800%
	65 -96	1.6200%	3.1800%	1.9300%

Table 3:	Descriptive	statistics	on individual	characteristics
		0 00 01 0 01 0 0		

Source: Calculations by the author.

Table 3 shows the spread of account holders according to individual characteristics: gender, education level, income quintiles and age. The distribution is in regard to the individual characteristics given for the respondents that have an official account solely, the respondents holding a mobile money account solely, and the respondents with both a formal account and a mobile money account. It is observed that among the respondents with both a formal account and a mobile money account, the proportion of men is close to 66% as compared to a proportion of women of close to 34%. These proportions change to 65% and 35% for men and women, respectively, in the context of the holding of a formal account solely. As concerns holding of a mobile money account solely, one moves from a proportion of close to 64% for men to a proportion of close to 36% for women. Thus, in the three contexts considered, it is in the context of the holding of a mobile money account solely that a larger proportion of women with an account is at its highest, followed by the context of holding an official account solely. In the three cases, the highest proportion of individuals holding accounts are men.

Among the respondents that have attained at least the level of secondary education and higher, it is noted that close to 66% hold both types of accounts, close to 60% hold an official bank account solely, and close to 51% hold a mobile money account solely. Thus, among the respondents that have at least a primary level of education, only close to 34% hold both a formal account and a mobile money account, while close to 40% hold a formal account solely and close to 49% hold a mobile money account solely. These statistics indicate that in the three alternatives for the use of financial services considered, the well-educated individuals constitute the highest percentage in terms of holders of accounts.

Furthermore, we observe a higher concentration in various categories of respondents in the active age-group (25-64). The proportions are of close to 94%, 93% and 91% for holders of both types of accounts, holders of official bank accounts solely, and holders of mobile money accounts solely, respectively. Contrary to the active age-group, the youth (15-24) have less access to finance. We observe the percentages of close to 5%, close to 4%, and close to 7%, respectively, for respondents with both types of accounts, for young respondents with official bank accounts solely, and for those with a mobile money account solely. We observe in the final analysis that youth in WAEMU countries have lower tendencies to hold accounts, be they mobile money accounts or formal bank accounts.

In terms of income, it is observed that a majority of respondents who had accounts are within the two highest income quintiles (20% richest and fourth 20% most rich). These two quintiles represent close to 80%, close to 74%, and close to 64%, respectively, of holders of both accounts at the same time, of holders of a formal bank account solely, and those that have a mobile money account solely. In the quintile of lowest income, there are percentages of close to 25%, of close to 26%, and of close to 39%, respectively, of respondents that have both types of accounts, those with a formal bank account solely, and those with a mobile money account solely. Thus, the poorest individuals have a lower tendency within WAEMU countries to open accounts, be they mobile money accounts or official bank accounts.

In summary, we observe that in WAEMU the holding of accounts, be they mobile money accounts solely, official bank accounts solely or the two types of accounts concurrently, is higher among men, and older and richer individuals. Nevertheless, in the three contexts of account holding addressed, women, youth and the less educated individuals and the poor are more represented in the categories of holders of mobile money accounts solely.

Results of the study

Determinants of the use of accounts in WAEMU

Table 4 shows estimations of the examination of the link between individual and country characteristics and the measures of the use of accounts. In column (1), (5) and (9), the probability of holding a mobile money account solely, the probability

of holding a formal bank account solely and the probability of holding both types of accounts at the same time, are respectively considered. In columns (2), (3), (4), (10), (11) and (12), the probability of sending money though mobile money, the probability of receiving money through mobile money, and the probability to carry out the payment of public utility bills through mobile money, are considered. In columns (6), (7) and (8), are found the probability of using a formal bank account for saving, the probability of using a formal bank account for saving, the probability of using a formal bank account for saving the carry out at least three withdrawals per month from a formal bank account. In each of the columns in the table, we find coefficients of estimations and marginal effects that capture how the probability of the use of an account changes with each adjustment in value or a regressor, while maintaining the other variables as constants.

Columns (1), (5) and (9) of Table 4, respectively, show simple probit estimations on the probability of holding a mobile money account solely, a formal account solely, and both a formal account and a mobile money account in WAEMU; whereas columns (2), (3), (4), (6), (7), (8), (10), (11) and (12) present probit estimation results in which one takes into account the selection problem resulting from the fact that the probability of using an account or not is only observed in people that previously held accounts. Furthermore, due to the transversal nature of the data, the estimated coefficients can only be interpreted as significant co-relationships between individual characteristics and measure of financial inclusion, and not as causal relationships (see Allen et al, 2016).

The results presented in columns (1), (5), and (9) show that the probability of possessing a mobile money account solely or a formal bank account solely or both accounts concurrently decrease for women as compared to men. These results are only significant in regard to holding a mobile money account solely and a formal bank account solely. For example, in column (1), the marginal effects show that in WAEMU countries, the probability of holding a mobile money account solely is close to 1 percentage point lower for women than for men, then in column (5), the probability of having a formal bank account solely is close to 3 percentage points lower for women than for men. Furthermore, the probability of possessing a mobile money account solely or a formal bank account solely or both at the same time significantly decreases for people with lower levels of educations (primary cycle or less). For example, it is noted that people that have a primary level of education or lower are, respectively, close to 1, 13, and 4 percentage points less likely than their better educated contemporaries to hold a mobile money account solely, a formal bank account solely, and both accounts concurrently. In the three listed cases, this probability significantly increases with age for individuals in the highest income quintiles.

Table 4: The determinants of the use of accounts (mobile money accounts, formal bank accounts and mobile money accounts in the context of the ownership of both types of accounts) in WAEMU

=				nuti types	כוווחטטט ווט							
Mode of financial services used		Mobile m	oney solely			Formal fin	ance solely		doM	ile money an	d formal finar	lce
Dependent variables	Mobile account	Sending	Receiving	Payment	Formal account	Savings	Borrowing	Withdrawals	Mobile and formal accounts	Sending	Receiving	Payment
Regressions	Probit	Probit / selection	Probit / selection	Probit / selection	Probit	Probit / selection	Probit / selection	Probit / selection	Probit	Probit / selection	Probit / selection	Probit / selection
Explanatory variables	1	2	£	4	S	9	7	8	6	10	11	12
Female	-0.1606*** (0.0558) -0.0146	-0.1569 0.1043 -0.0055	-0.0219 (0.0951) -0.0015	-0.0428 (0.2478) -0.0005	-0.1457*** (0.0544) -0.0268	-0.1310 (0.1110) -0.0347	-0.0843 (0.1180) -0.0043	-0.0603 (0.0805) -0.0019	-0.0996 (0.0833) -0.0067	-0.2122*** (0.0565) -0.0060	-0.0413 (0.1160) -0.0008	-0.2255 (0.2426) -0.0035
Age	0.0283*** (0.0086) 0.0026	0.0540*** 0.0099 0.0019	-0.0333 (0.0253) -0.0022	0.0720*** (0.0125) 0.0008	0.0919*** (0.0165) 0.0169	0.0800* (0.0412) 0.0212	0.0966*** (0.0166) 0.0050	0.0637*** 0.0207) 0.0021	0.0698*** (0.0234) 0.0047	0.1361*** (0.0447) 0.0039	0.0850*** (0.0285) 0.0017	0.1720*** (0.0390) 0.0027
Age squared	-0.0005*** (0.0001) -0.0000	-0.0007*** 0.0001 -0.0000	0.0004 (0.0003) 0.0000	-0.0009*** (0.0001) -0.0000	-0.0009*** (0.0002) -0.0002	-0.0009** (0.0004) -0.0002	-0.0010*** (0.0002) -0.0001	-0.0006** (0.0003) -0.0000	-0.0008*** (0.0003) -0.0001	-0.0017*** (0.0006) -0.0000	-0.0010** (0.0004) -0.0000	-0.0022*** (0.0005) -0.0000
Education: Primary	-0.0989 (0.0977) -0.0090	-0.0887 0.0902 -0.0031	0.1902 (0.1294) 0.0128	-0.8134*** (0.2215) -0.0089	-0.6968*** (0.0836) -0.1283	-0.3446 (0.3671) -0.0913	-0.4718*** (0.1107) -0.0243	-0.4605*** (0.1235) -0.0148	-0.6220*** (0.1068) -0.0417	-0.8716*** (0.0920) -0.0247	-0.7210*** (0.1892) -0.0142	-0.6866*** (0.1615) -0.0106
Income: The top 20%	-0.0697 (0.1049) -0.0063	0.1198 0.1790 0.0042	0.0438 (0.1268) 0.0029	0.4395 (0.3413) 0.0048	0.6962*** (0.1110) 0.1282	0.7894** (0.3633) 0.2092	0.5364*** (0.1775) 0.0277	0.5006*** (0.1763) 0.0161	0.6715** (0.2698) 0.0450	0.5161** (0.2498) 0.0145	0.1534 (0.1654) 0.0030	0.5520** (0.2614) 0.0085
Income: Fourth 20%	0.0736 (0.0747) 0.0067	0.2049 0.2108 0.0071	-0.2162 (0.2087) -0.0145	0.3605 (0.3534) 0.0040	0.2965*** (0.0715) 0.0546	0.5981** (0.2754) 0.1585	0.2093 (0.1737) 0.0108	0.0758 (0.1824) 0.0024	0.4671** (0.2319) 0.0313	0.3750* (0.1968) 0.0106	0.0398 (0.3643) 0.0008	0.4556* (0.2530) 0.0070
											continued	next page

Mode of financial services used		Mobile m	oney solely			Formal fin	iance solely		doM	ile money an	d formal finar	lce
Dependent variables	Mobile account	Sending	Receiving	Payment	Formal account	Savings	Borrowing	Withdrawals	Mobile and formal accounts	Sending	Receiving	Payment
Regressions	Probit	Probit / selection	Probit / selection	Probit / selection	Probit	Probit / selection	Probit / selection	Probit / selection	Probit	Probit / selection	Probit / selection	Probit / selection
Explanatory variables		2	m	4	5	Q	7	œ	6	10	11	12
Income: Second 20%	-0.1063 (0.1071) -0.0097	-0.1377 0.1494 -0.0048	0.0999 (0.2780) 0.0067	-0.2456 (0.5547) -0.0027	-0.0260 (0.0583) -0.0048	0.3087 (0.3778) 0.0819	-0.0142 (0.1369) -0.0007	0.0758 (0.1687) 0.0024	0.0539 (0.1884) 0.0036	0.0762 (0.0909) 0.0022	-0.2407 (0.3396) -0.0047	-0.2611 (0.4227) -0.0040
Television (% Households)	0.1580*** (0.0020) 0.0144				0.0119*** (0.0012) 0.0022				0.0278*** (0.0023) 0.0019			
Bank Branches	-0.6493*** (0.0127) -0.0591	0.3152** 0.1244 0.0110	0.5798*** (0.1940) 0.0389	0.3845*** (0.0973) 0.0042	0.1302*** (0.0034) 0.0240	0.2960*** (0.1057) 0.0784	-0.0659 (0.0425) -0.0034	0.2884* (0.1624) 0.0093	0.2136*** (0.0125) 0.0143	0.1373 (0.0945) 0.0039	0.1781 (0.1154) 0.0035	0.0514 (0.1506) 0.0008
Micro- finance Institutions	0.00005*** 0.00000	-0.0004 0.0003 -0.0000	-0.0019*** (0.0007) -0.0001	-0.0014*** (0.0004) -0.0000	-0.0006*** (0.0000) -0.0001	0.0002* (0.0001) 0.0000	0.0007** (0.0003) 0.0000	0.0001 (0.0001)	-0.0018*** (0.0001) -0.0001	0.0006 (0.0004) 0.0000	-0.0004 (0.0004) -0.0000	-0.0004 (0.0005) -0.0000
Mobile money agencies	0.0067*** (0.0002) 0.0006	0.0038** 0.0018 0.0001	0.0063** (0.0025) 0.0004	0.0080*** (0.0014) 0.0001					-0.0041*** (0.0002) -0.0003	0.0009 (0.0015) 0.0000	-0.0004 (0.0011) -0.0000	0.0026** (0.0011) 0.0000
Financial freedom index	-0.0789*** (0.0010) -0.0072	0.0310*** 0.0099 0.0011	-0.0745** (0.0295) -0.0050	0.0216 (0.0224) 0.0002	-0.0317*** (0.0008) -0.0058	0.0240** (0.0098) 0.0063	-0.0115* (0.0063) -0.0006	-0.0188*** (0.0065) -0.0006	-0.0866*** (0.0041) -0.0058	0.0373*** (0.0143) 0.0011	0.0218 (0.0136) 0.0004	0.0480 (0.0473) 0.0007

Table 4 Continued

aor	Payment	Probit / selection	12	-7.9436*** (1.9438)	Yes		6,869
ile money and formal fina	Receiving	Probit / selection	11	-5.0550*** (1.0536)	Yes		6,854
	Sending	Probit / selection	10	-7.0053*** (0.9753)	Yes		6,914
Mok	Mobile and formal accounts	Probit	6	0.6745 (0.4076)	Yes	0.1600	6,995
	Withdrawals	Probit / selection	8	-4.1596*** (0.8711)	Yes		6,994
Formal finance solely	Borrowing	Probit / selection	۷	-3.6065*** (0.5612)	Yes		6,989
	Savings	Probit / selection	9	-4.8862*** (0.9108)	Yes		6,988
Mobile money solely	Formal account	Probit	5	-2.3181*** (0.3056)	Yes	0.1803	6,995
	Payment	Probit / selection	4	-7.0949*** (1.0319)	Yes		6,727
	Receiving	Probit / selection	3	3.3960*** (0.5116)	Yes		6,849
	Sending	Probit / selection	2	-6.1172*** 0.6709	Yes		6,792
	Mobile account	Probit	-	-1.1876*** (0.1651)	Yes	0.1716	6,995
Mode of financial services used	Dependent variables	Regressions	Explanatory variables	Constant	Fixed country effects	Pseudo R ²	Observations

Votes: ***, ** and * represent a significance threshold of 1%, 5%, and 10%, respectively. Error types are placed in parentheses. Marginal effects are in italics. The different cells give he results of the regression of an indicator of financial inclusion (Mobile account, Formal account, Formal and mobile accounts, Sending, Receiving, Payment, Savings, Borrowing and Withdrawals) on the total individual and country characteristics. "Mobile account" refers to adults who declare they hold a mobile money account solely. "Formal account" refers that preceded the survey, through their mobile money accounts. "Receiving" refers to adults who declared to have received money from a relative or a friend living in a different zone country where the survey was undertaken) in the 12 previous months, including money received in person from their private mobile money account, "Payment" refers to adults who have declared to have personally undertaken regular payments for electricity, water, or garbage collection through the use of mobile money, "Withdrawals" refers to adults who declare to adults who have declared to hold an account in a formal financial institution solely. "Formal and mobile account" refers to adults with both a formal and a mobile money account. Sending" makes reference to adults who declare to have sent money to a relative or friend living in a different zone (country where the survey was undertaken) in the 12 months o have withdrawn money from their personal account at least thrice over the course of a normal month, "Borrowing" refers to adults who declare to have borrowed money through their private accounts in a normal month, "Savings" refers to adults who declared to have saved or put aside money in the past 12 months using an account in a financial institution. Probit indicates the estimation of an equation such as a probit model by maximum likelihood. Probit/selection corresponds to a simultaneous estimation of the selection equation holding of accounts) with the equation of the result (use of accounts) by maximum likelihood. Sampled countries: Benin, Burkina Faso, Ivory Coast, Mali, Niger, Senegal and Togo.

But, although the probability of having a mobile money account solely shows no significant result among individuals in the highest income quintiles, that of possessing a formal account solely and both types of accounts is higher among individuals in the highest income guintiles. It is observed that access to media shows positive significant result with the probability of holding a mobile money account solely, a formal account solely and both types of accounts. Considering financial intermediaries' availability, it is observed that while there is a negative significant relationship between the probability of possessing a mobile money account solely and the availability of bank branches, there is a positive significant relationship between this probability and the availability of mobile payment agencies and microfinance institutions. Also, while the probability of holding a formal account solely has a significant positive relationship with the availability of bank branches, this probability has a negative significant relationship with the availability of microfinance institutions. Furthermore, it is observed a positive significant relationship between the probability of holding both types of accounts and the availability of bank branches and microfinance institutions. But, there is a negative significant relationship between this probability and the availability of mobile payment agencies. Concerning financial freedom index, it is observed a negative significant relationship between the probability of holding a mobile money account solely, a formal account solely and the level of financial freedom.

In summary, opening an account in WAEMU is more probable amongst men, older individuals, highly educated individuals and those that are richer. These results are similar to those reviewed above under the rubric of statistics on account holders. Furthermore, these results are similar to those of Demirguc-Kunt and Klapper (2013) using Global Findex data from 2011, who find that in the African context, women and adults with lower levels of education are less likely to open an official bank account, while adults in the higher income quintiles are more likely to open a formal bank account. Equally, the results by Soumaré et al (2016), which also show that individuals with higher levels of education and those that are more active are more likely to hold a bank account in West and Central African countries, are confirmed by the results of this study.

Within the framework of using a mobile money account solely, we note that the probability of sending money through a mobile money agent and that of undertaking the payment of public utility bills through mobile money are significantly higher among the older individuals and those who are in the higher income quintiles, but the probabilities are significantly lower among the individuals with lower levels of education. It is also observed that these probabilities significantly increase with the number of bank branches and mobile payment agencies. It is noted on the whole that, although the gender factor does not show any significant result, women seem to be least likely to send money through mobile money. For example, the probability to send money and to effect bill payments through mobile money is almost 1 percentage point higher among people in the highest income quintiles than for those in the lower income quintiles. The probability to send money and effect bill payments by mobile

money is close to 3 and 1 percentage points, respectively, lower among individuals with lower levels of education than among those with higher levels of education.

In the context of the use of an official bank account solely, we note that the probability of saving, borrowing and that of undertaking at least three withdrawals per month from one's account significantly increases with age among individuals in the higher income guintiles. However, these probabilities significantly reduce among people with lower levels of education. It is also noted, within the probability framework, that borrowing significantly increases according to the number of bank branches. However, the possibility of savings significantly increases with the number of micro-finance institutions. For example, it is noted that the probability to save, to borrow and to effect at least three withdrawals per month is, respectively, close to 21, 3, and 1 percentage points higher among people in the higher income quintiles than those in the lower income quintiles. The probability to save is close to 10 percentage points lower among the less educated people than among those with higher levels of education. The probability to borrow and to carry out at least three withdrawals in a month from a formal bank account are, respectively, close to 2 and 1 percentage points lower among less educated people than among those with higher levels of education.

Moreover, in regard to the holding of the two types of accounts, it is noted that the probability to send money by mobile money increases significantly with the number of bank branches and mobile payment agencies, while that of receiving money through mobile money does not significantly increase with the number of bank branches. However, it is noted that the probability to effect public utility bill payments through mobile money significantly decreases among people in the lowest income quintiles.

Overall, there is a significant negative relationship between the probability of owning an account and the level of financial freedom. But, a positive significant relationship between the probability of sending money through mobile money and the level of financial freedom is observed, whereas there is a negative significant relationship between the probability of receiving money through mobile money and the level of financial freedom. Also, while there is a positive significant relationship between the probability of saving and the level of financial freedom, there is a negative relationship between the probability of borrowing, the probability of making at least three withdrawals per month and the level of financial freedom.

These sets of results show that the least vulnerable social categories, that is men, the older, the most educated and the richest, are the ones who use mobile money the most. These results are similar to those arrived at in regard to holders of formal bank accounts in this study, and others (see Allen et al, 2016).

We note that in the context of holding a mobile money account solely or a formal bank account solely, the results, which confirm a higher use of accounts when there is the easy access to financial intermediaries, agree with the conclusions arrived at by Allen et al (2016).

Analysis of robustness

This section presents multinomial probit regressions in Table 5 that are aimed at testing the robustness of previous results obtained by the two-step Heckman method. Thus, it analyses various structures of decisions related to the use of financial services through all the three modalities. Within the framework of holding a certain type of account for the conduct of financial operations, the decision-maker has three alternatives that are: 0: not having an account, 1: having one account (mobile money account solely or formal account solely) and 2: having both a mobile money account and a formal financial account. In this context, given that the variable representing holders of no account appears most frequently among the three alternatives listed, it is retained as the reference category. In regard to the choice of sub-sets of usage related to different accounts, this study associates the formal bank account with three alternatives which are: 0: if the individual uses no formal financial service, 1: if the individual uses one formal financial service (savings or at least three withdrawals per month) and 2: if the individual uses two formal financial services (both savings and at least three withdrawals per month). In regard to mobile money, it is generally related to three alternatives, which are: 0: if the individual uses no mobile money service, 1: if the individual uses one mobile money service (sending or receiving money through a mobile phone) and 2: if the individual uses two mobile money services (both sending and receiving money through a mobile phone). In the process of regression of a multinomial probit, the alternatives with the highest frequency were retained as reference categories for each context. In the context of the use of formal bank account, the alternative "not effecting any formal financial operation" is the reference category. In the context of the use of mobile financial services, the alternative that was taken as the reference category was "not effecting any mobile money operation".

Within the framework of the holding of an account in the financial services sector, the results suggest that the probability of opening an account, as compared to that of not holding any account, has significantly dropped among women and individuals with the lowest levels of education. However, this probability is significantly higher among older individuals in the different contexts of holding accounts, whereas it is significantly higher among those with higher income levels only in the context of holding a formal bank account and the two types of accounts. Moreover, this probability is significantly higher in the context of holding a formal bank account and the two types of accounts. Moreover, this probability is significantly higher in the context of holding a formal bank account solely, with the number of micro-finance institutions, in the context of holding a mobile money account solely, with the number of bank branches and mobile money agencies and within the framework of the holding of the two account types with the number of bank branches. These results are similar to those arrived at while using the Heckman selection model.

Table 5:	The determin	nants	of	the	use	of	accounts	in	WAEMU:	Estimations	using
	a multinomial	probit									

Dependent variables	Choice of a financi account (f category: have an a Holding one account solely (formal or mobile account)	f holding al sector Reference Does not account) Holding both mobile and formal accounts	Choice of a fo service a (Reference c not effect financial Use one formal financial service (savings or With- drawals)	ormal financial alternative any formal operation) Use two formal financial services (savings and Withdrawals)	money service alternative (Reference category: Does not effect any mobile money operation) Use one mobile money service (sending or receiving) Use one mobile money service (sending or receiving)		
Explanatory variables	1	2	3	4	5	6	
Female	-0.2653***	-0.2332***	-0.0722	-0.1564	-0.1048	-0.1590	
	(0.0542)	(0.0891)	(0.0662)	(0.0988)	(0.0793)	(0.1157)	
Age	0.1206***	0.1333***	0.1316***	0.1612***	0.0417***	0.0861***	
	(0.0093)	(0.0180)	(0.0119)	(0.0193)	(0.0141)	(0.0253)	
Age squared	-0.0013***	-0.0015***	-0.0014***	-0.0017***	-0.0006***	-0.0012***	
	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0003)	
Primary	-0.9419***	-1.1685***	-0.7748***	-0.9593***	-0.6960***	-0.7273***	
education	(0.0637)	(0.1021)	(0.0778)	(0.1127)	(0.0946)	(0.1355)	
Income: The top 20%	0.8401***	1.2039***	0.7656***	1.2398***	0.0341	0.7978***	
	(0.0882)	(0.1730)	(0.1096)	(0.2034)	(0.1315)	(0.2242)	
Income:	0.3673***	0.7501***	0.2596**	0.4802**	-0.0265	0.6055***	
Fourth 20%	(0.0922)	(0.1809)	(0.1164)	(0.2196)	(0.1364)	(0.2304)	
Income: Intermediary 20 %	0.1008 (0.0977)	0.5271*** (0.1894)	0.0083 (0.1256)	0.4703** (0.2251)	-0.2021 (0.1459)	0.1781 (0.2503)	
Income:	-0.1046	0.0555	-0.1935	0.2409	-0.1466	0.0487	
Second 20%	(0.1018)	(0.2122)	(0.1334)	(0.2377)	(0.1483)	(0.2660)	
Television (% Households)	0.0546*** (0.0075)	0.0566*** (0.0123)					
Bank	0.0849**	0.3132***	0.1497**	0.1870*	0.3137***	0.5253	
branches	(0.0339)	(0.0497)	(0.0685)	(0.1068)	(0.0347)	(0.0596)	
Micro- finance institutions	-0.0026*** (0.0003)	-0.0034*** (0.0005)	0.0019*** (0.0003)	0.0019*** (0.0004)	0.0008*** (0.0002)	0.0004 (0.0004)	
Mobile money agencies	-0.0066*** (0.0008)	-0.0077*** (0.0014)			0.0049*** (0.0007)	0.0072*** (0.0012)	
Financial freedom index	-0.0852*** (0.0166)	-0.1459*** (0.0287)	-0.0173 (0.0155)	-0.0489** (0.0237)	0.0489*** (0.0069)	0.0552*** (0.0114)	
Constant	1.0674	1.9823	-4.5984***	-5.0354***	-5.9142***	-9.2501***	
	(0.8407)	(1.4371)	(0.6085)	(0.9441)	(0.4451)	(0.7748)	

Table 5 Continued

	Choice of a financia account (F category: have an a	^E holding al sector Reference Does not account)	Choice of a fo service a (Reference c not effect financial	ormal financial Ilternative ategory: Does any formal operation)	Choice of a mobile money service alternative (Reference category: Does not effect any mobile money operation)		
Dependent variables	Holding one account solely (formal or mobile account)	Holding both mobile and formal accounts	Use one formal financial service (savings or With- drawals)	Use two formal financial services (savings and Withdrawals)	Use one mobile money service (sending or receiving)	Use two mobile money services (sending and receiving)	
Explanatory variables	1	2	3	4	5	6	
Fixed country effects	Yes	Yes	Yes	Yes	Yes	Yes	
Log- likelihood	-3744	.9323	-256	6.4269	-1834.3665		
Observations	6,9	50	6,	950	3,697		

Notes: ***, ** and * represent a significance threshold of 1%, 5%, and 10%, respectively. Error types are given in parentheses. The different cells give the results of the regression of an indicator of financial inclusion (Hold one account (mobile account or formal account), hold two accounts (mobile account and formal account), Use one formal financial service (savings or withdrawals), Use two types of formal financial services (Savings and withdrawals), Use one mobile money service (Sending or receiving), Use two types of mobile money services (Sending and receiving)) on a set of individual and country characteristics. "Mobile account" refers to adults who declare they hold a mobile money account solely. "Formal account" refers to adults who have declared to hold an account in a formal financial institution solely, "Formal and mobile account" refers to adults with both a formal and a mobile money account, "Sending" makes reference to adults who declare to have sent money to a relative or friend living in a different zone (country where the survey was undertaken) in the 12 months that preceded the survey, through their mobile money accounts. "Receiving" refers to adults who declared to have received money from a relative or a friend living in a different zone (country where the survey was undertaken) in the 12 previous months, including money received in person from their private mobile money account, "Withdrawals" refers to adults who declare to have withdrawn money from their personal account at least thrice over the course of a normal month, "Savings" refers to adults who declared to have saved or put aside money in the past 12 months using an account in a financial institution. Sampled countries: Benin, Burkina Faso, Ivory Coast, Mali, Niger, Senegal and Togo.

In columns (3) and (4), the probability of using formal financial services, as compared to the probability of not carrying out any formal financial transaction, is significantly higher with age and among the individuals with higher levels of education. Particularly in columns (3) and (4), this probability is higher among the individuals with the highest income. In column (3) and (4), the probability of using at least one formal financial service, in relation to the probability of not effecting any formal financial transaction, significantly increases with the number of micro-finance institutions and bank branches. On the whole, these results that are linked to the individual characteristics related to the use of a formal bank account solely, which

are obtained through a multinomial probit are similar to those arrived at through the use of a Heckman selection model.

In columns (5) and (6), the probability of using at least one mobile money service, compared to that of not carrying out any mobile money service transaction, is significantly higher among older individuals and people with higher levels of education and financial freedom and with the number of mobile money agencies. In column (5), the probability of using only one mobile money service, compared to that of not carrying out any transaction on mobile money, significantly increases with the number of micro-finance institutions and bank branches. In column (6), the probability of using two mobile money services, compared to that of not carrying out any transaction on mobile money individuals with the highest income. Thus, richer people are more likely to use two mobile money services than the poor. Particularly, in columns (5) and (6), the probability of using at least one mobile money, is significantly low among women. The individual characteristics associated with the use of mobile money services thus obtained are on the whole similar to those etablished using the Heckman selection model.

5. Conclusion

In seeking to contribute to the growth in the use of mobile money in WAEMU, this study verifies whether, under the effects of the impacts of the penetration of financial institutions, the individual characteristics of users of mobile accounts solely are similar to the characteristics of those who use official bank accounts solely, and to those that use both types of accounts concurrently. In order to do so, data from a survey undertaken in 2014 by Global Findex on seven WAEMU countries is used simultaneously with a set of aggregated data related to the penetration of financial institutions. The empirical analysis adopted builds on a multi-level approach and the Heckman (1979) selection method. Multinomial probit regressions are also used to verify the robustness of the regressions undertaken through the Heckman selection model.

The results reveal that in a manner that is similar to the use of a formal bank account solely or the two types of accounts concurrently, a higher use of mobile money solely is associated with men, older individuals, individuals with the highest levels of education, those with the highest income levels, and to easy access to mobile money agencies.

The increase in the use of mobile money with age could be explained through the fact that active individuals are generally those who engage in practices that require the possession of an account to receive salaries and various payments. Besides, the increased use of mobile money in the presence of a higher availability of mobile money agencies could be explained through the fact that most holders of mobile money accounts use these agencies to credit their accounts. Thus, the proximity of mobile payment agencies motivates a higher and more regular use of mobile money. The higher use of mobile money by individuals with higher levels of education could be explained through the fact that operations of sending and receiving money through mobile money require the capacity to read about transfers and balances that are available in the account. A higher use of mobile money by those with higher levels of income could be explained by the fact that an active mobile money account requires regularity in terms of movement of funds through sending, receipt, and payment. Thus, mobile money accounts are generally more active when held by individuals with higher incomes.

From the various results, to encourage an increase in the level of financial inclusion through mobile money in WAEMU countries, policy makers should:

 Focus on the sensitization of people aged 25-64 in terms of the use of mobile financial services. Such an action could be done through financial literacy programmes;

- Work on a rise in the levels of individual income. This could be done by an increase in minimum wage;
- Encourage increase in education levels through an introduction of incentives in education systems to promote the attainment of the highest levels of education by the largest number of people. In this regard, sensitization programmes on the benefits of a good education and the provision of education bursaries could be explored;
- Give particular attention to the geographic penetration of mobile payment agencies and encourage their localization at certain proximity so that they may be easily accessible to the largest number of people;
- Encourage leaders in WAEMU countries to pay particular attention to the establishment of basic infrastructure that would allow the greatest number of inhabitants to use the media, such as television, radio and the internet; and
- sEncourage leaders in WAEMU countries to review the degree of their implications in the operation of the activities of financial institutions so that they become more competitive.

A major limiting factor of this study is that it does not include various key variables such as matrimonial status, employment status, etc. Indeed, these variables do not feature in the study for the simple reason that they are not available to the public in the Global Findex database.

Notes

- 1. Financial Inclusion refers to the process that allows individuals and firms to access basic financial services (funds deposits and transfers, payments, savings, credit, insurance) provided by formal financial institutions (Banque de France, 2014).
- 2. Central Bank of West African States.
- 3. Essentially, mobile banking allows a user through the use of their mobile telephone, to access their bank account and to carry out basic transactions such as money transfer, balance verification, payment of bills, as well as making specific requests to their bank. However, mobile money also allows similar transactions using a mobile telephone, but from an account that does not necessarily need to be a standard bank account. In this case, a mobile telephone is linked to a pre-established common treasury and thus allows for the offer of services that are similar to those offered by mobile banking but without necessarily accessing complete banking services.

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