Unobserved heterogeneity in the analysis of mobile financial services use: Evidence from the City of Yaoundé

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Abstract

This study analyzes the use of mobile financial services (MFS) in the city of Yaoundé. Specifically, using data collected from 1200 individuals, it identifies the factors that explain the use of the different MFS available in this city through logistic regressions. Then, an extension of these analyses is proposed by the regression of a multivariate Probit under the hypothesis of interdependence between the different uses. Finally, a control function approach is used to correct for unobserved heterogeneity in the different MFS use equations. The results reveal that socio-economic factors such as age, socio-professional status and education level, functional factors, namely perceived safety and ease of use, and extra-functional factors, namely perceived usefulness, differentially affect MFS use in Yaoundé.

1. Introduction

In recent years, the development of mobile telephony has had a significant impact on the activity of individuals (Sang and Lara 2011). Its remarkable expansion has generated growing enthusiasm given its potential for financial inclusion in developing countries where cell phone penetration is far higher than that of formal financial institutions. Due to its high penetration, the cell phone will become a preferred means of delivering financial services (FS) to populations on the margins of the traditional financial sector (Saifullahi and Haruna 2020). It represents a market that continues to grow around the world and particularly in Africa. The GSMA (2015) report on the state of MFS counts about 203 million MFS customers worldwide, 98 million in sub-Saharan Africa with a high concentration in East Africa (34% of customers). Today, nearly 36 of the 54 countries on the African continent offer MFS.

The experiences of M-PESA[1] initiated in Kenya in 2007 and generalized in many African countries testify to the success of MFS in developing countries (Dissaux 2019) and several studies agree on the advantages of these services. Benefits in terms of both cost and security (according to McKay and Pickens (2010), MFS are on average 19% cheaper than services offered by banks and decentralized financial systems. These authors show that in Kenya, M-PESA saves a third of the usual costs, thus promoting savings for poor clients), and in terms of mobility and physical accessibility (the density of the mobile point network offers users proximity and autonomy. For Mago and Chitokwindo (2014), through MFS, FSs reach the most remote areas where traditional financial institutions have always been physically absent) which, influence the decision to use FSs in an African context marked by high financial exclusion. Indeed, the figures on financial inclusion in developing countries and particularly in Sub-Saharan Africa still reflect a high level of exclusion: according to Demirguc-Kunt *et al*. (2018), the average rate of financial inclusion in the broad sense is only 43% in Sub-Saharan Africa and 63% in developing countries. According to these authors, the rate in the narrow sense is 33% in Sub-Saharan Africa and 61% in developing countries. Several obstacles (high cost of services, burdensome documentary requirements, lack of income, inadequate and concentrated infrastructure in urban centers, etc.) are widely documented to explain this low financial inclusion. However, since the resounding success of M-PESA, MFS is increasingly emerging as an effective means of financial inclusion for those excluded from the traditional financial sector (Eilu and Auma 2017; Senou *et al*. 2019), and is being prioritized by policymakers to improve access to FS.

In Cameroon, MFSs have also evolved dramatically over the years. This is true both in terms of account opening, activity rate, and volume and value of transactions. Indeed, despite the many barriers (lack of information, lack of cell phone, lack of network coverage, lack of income, difficulty of use, lack of trust) to its adoption/use (FinScope 2017), the number of MFS subscribers reached 8, 003,252 in 2017. That is a growth of more than 110.24% and a gain compared to the year 2016, of 4.19 million new subscribers (ART[2] 2017). According to data collected in 2017 from the main MFS platforms in Cameroon (MTN and Orange), the number of active accounts increased (+139.8%), while the number of accounts created climbed by

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[1] M for mobile and PESA means money in Swahili.
[2] Telecommunications Regulatory Agency.

66.7%. Between 2016 and 2017, a significant improvement in the account activity rate was also observed, rising from 54.4% in 2016 to 79.2% in 2017, compared to only 37.8% in 2015. While the value of mobile transactions almost tripled (from 870 billion in 2016 to 2,577.8 billion in 2017), as did the number of transactions (+266.7%), reflecting a strong use of MFS in Cameroon. Such a craze raises questions about the use behavior of individuals. Thus, it is interesting to consider the factors that explain the use of these new services. In other words, what explains the choice of individuals for MFS or for a specific MFS rather than another? The objective of this study is therefore to profile the users of the different MFS available in the city of Yaoundé[3]. We postulate that MFS use behavior cannot be explained solely by traditional utility maximization or rationality assumptions. This suggests that social, cultural, functional and extra-functional factors are essential to determine the choice of MFS use.

Several contributions stem from this study. Indeed, if it allows firstly to enrich the empirical literature on financial inclusion through the role played by financial innovations such as MFS, it also attempts to go beyond the traditional explanation of the behavior of individuals based essentially on the only hypotheses of utility maximization and rationality, to highlight the role of social, cultural, functional and extra-functional factors. Finally, it makes it possible to take into account the specificities of the different MFS whose use can vary greatly from one individual to another (intuitively, the probability of sending money by mobile phone would be higher among rich people unlike poor people who would rather be more likely to receive money by mobile). This study is structured as follows: it first examines the theoretical and empirical explanations on which the choice of use of MFS is based (section 2), before carrying out an empirical analysis of the explanatory factors for the use of this new type of financial services (section 3) and finally to discuss the results (section 4).

2. Literature review

The extensive literature on the determinants of MFS adoption and use in developing countries provides sufficient evidence of the interest in MFS in these countries (Kingiri and Fu 2019). In general, two broad categories of work stand out in this literature. While the first category explains the adoption and use decision through functional characteristics such as perceived safety, convenience or ease of use; the extra-functional characteristics including perceived usefulness, perceived transaction cost or contextual characteristics such as perceived risk (Hanafizadeh *et al*. 2014; Lai and Zainal 2015; Lai 2016 ; Narteh *et al*. 2017), the second category focuses instead on socioeconomic and cultural factors to explain this decision to adopt and use MFS (Asongu *et al*. 2020; Fall *et al*. 2020; Ndiaye and Weibigue 2020; Hisahiro and Shinnosuke 2022).

Using data collected from 1052 individuals in the suburbs of Dakar, Fall *et al*. (2020) analyze the adoption and use of MFS by low-income individuals in Senegal. Using the Heckman selection model, they find that individual characteristics such as education level, bank account ownership, and family network effects are determinants of adoption. While age, gender, and tontine membership are explanatory factors for MFS use. A major finding of this work is the

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[3] It is the political capital of Cameroon, which concentrates the Central Business Center. That is to say: administrative activities, commercial activities, schools, universities, etc.

low propensity of females to adopt MFS. However, the study found that compared to men, women have a higher propensity to use when they adopt. Asongu *et al.* (2020) use a Tobit model regression to analyze the wider diffusion of MFS in Africa. The authors find that bank concentration has a negative influence on the adoption of these services. However, it does not have a negative impact on the use of MFS, especially for sending and receiving money via mobile phones. The study also finds that cell phone ownership has a positive effect on the use of MFS in Africa. In addition to cell phone ownership, there is some work that links mobile network accessibility to FMS use. This is the case of the work of Hisahiro and Shinnosuke (2022) which shows that network accessibility is positively associated with FMS use in Pakistan and Tanzania. The authors find that in these countries, when a household's location is within 10 km of the center of the area with multiple mobile networks, the probability of using FMS increases by 10%.

Some work has focused on demonstrating the influence of functional, extra-functional, and contextual factors on individuals' decision to use MFS. This is the case with the work of Wessels and Drennan (2010), who opt for the extended TAM to explain and predict consumers' intentions to use mobile banking in Australia. The authors conclude that perceived usefulness, compatibility, perceived risk, perceived cost, and attitude are the primary determinants of consumers' intention to use mobile banking. Drawing on data collected from 638 respondents, Lai (2016) attempts to identify MFS characteristics that may influence the intention to use mobile payment among households in Malaysia. Using structural equation estimation, the author finds that design, perceived risk, perceived usefulness, and ease of use are the factors that predominantly influence the intention to use mobile payment within these households.

This non-exhaustive review of the literature first highlights the scarcity of works analyzing the use of MFS in the Cameroonian context. In an attempt to fill this gap, our analysis focuses on one of the largest cities in Cameroon, namely the city of Yaoundé, which concentrates in its center the Central Business Center (i.e. administrative and commercial activities, schools, universities, etc.). Second, we can see that the majority of these works implicitly equate the adoption of MFS with its use. This is not always the case when we know that the adoption and use of a new technology or financial innovation like MFS follow different processes (Ghezzi *et al,* 2013). Indeed, an individual may subscribe to an MFS account (adoption) because of what his or her entourage suggests or because of advertising or promotions from mobile operators. But after this adoption, the latter may decide not to use MFS because of lack of money (to make remittances, savings payments), difficulty of use, or simply lack of utility of these services. To overcome this limitation, this study proposes to analyze in detail the actual use of MFS, different from adoption (measured by subscription or possession of an MFS account) by focusing on the set of MFS available in the MFS ecosystem in Cameroon, namely: sending, receiving, paying and saving by mobile. Finally, several studies focus solely on one category of factors (either only individual characteristics or only MFS characteristics) to explain MFS use. Such analyses provide partial or incomplete explanations of MFS use. This study, by focusing on both axes, has the merit of proposing much more complete explanations of the decision to use MFS, based on both the socioeconomic characteristics of the users and the characteristics of the different MFS.

3. Data and methodology

The study uses data from the Urban Survey of Participation in the Financial Sector, conducted in 2018 in the city of Yaoundé by the Center for Research in Economics and Management. The main purpose of this survey is to identify barriers to access, use, and satisfaction with FS by focusing on individuals' perceptions. The sample to which the questionnaire was administered consisted of 1200 individuals randomly selected in the seven districts of the city of Yaoundé. Table I describes the study variables and their composition in the sample. While 61% of the respondents use MFS, 39% say they do not. Use by type of service shows that mobile sending involves 59% of respondents, 63% are involved in receiving, 57% in payments and 64% in mobile savings. The use of MFS by gender of respondents reveals that 51% of men are MFS users compared to 44% of women. Regardless of the FMS, users in the [15-35] age group are in the majority. They represent 73% of all users, 71% of mobile senders, 74% of receivers, 72% of payments and 74% of mobile savers. Regarding the relationship with the level of education, we can see that the majority of MFS users have a higher level of education: 66% for all services, 64% for sending, 65% for receiving, 66% for paying and 66% for saving. These users are mostly employees (51% for all services, 56% for mobile sending, 50% for receiving, 52% for paying and 50% for saving) or apprentices. Users have a greater perception of the security, usefulness and ease of use of mobile services. They use these services because they find them easy to use and useful (94%) and secure (63%).

Table I: Descriptive statistics (in %)

Variable	Use	Sending	Receiving	Payment	Saving
Sample	61	59	63	57	64
Men	51	55	52	56	55
Women	44	45	48	44	45
[15-35[	73	71	74	72	74
[35-55[	24	27	24	25	24
[55-75]	3	2	2	3	2
Not in school	1	1	1	1	1
Primary	3	4	4	3	4
Secondary	30	31	30	30	29
Higher education	66	64	65	66	66
Unemployed	12	10	12	12	12
Apprentice	36	33	37	35	37
Employee	51	56	50	52	50
Retired	1	1	1	1	1
Single	63	61	64	61	65
Couple	34	36	33	36	32
Divorced/widowed	3	3	3	3	3
No religion	4	4	4	5	4
Christian	86	87	87	86	86
Muslim	10	9	9	9	10
Vulnerability	40	40	42	40	42
Formal account	38	40	37	39	37
Financial Knowledge	96	96	96	96	95
Security	63	64	64	64	63
usefulness	94	98	97	94	98
Ease of use	94	97	97	94	98

The first analyses in detail the explanatory factors of the use of MFS by focusing on the different MFS available. Under the hypothesis of non-simultaneity of use, we estimate four Logit models representing: sending money, receiving money, paying and saving:

$$
\begin{aligned}
sending = \; & \alpha_0 + \alpha_1 gender + \alpha_2 age + \alpha_3 education + \alpha_4 professional\ statut + \alpha_5 marital\ statut \\
& + \alpha_6 income + \alpha_7 religion + \alpha_8 financial\ knowledge + \alpha_9 vulnerability \\
& + \alpha_{10} formal\ account + \alpha_{11} security + \alpha_{12} utility + \alpha_{13} ease\ of\ + \varepsilon
\end{aligned}
\tag{1}
$$

$$
\begin{aligned}
receiving = \; & \alpha_0 + \alpha_1 gender + \alpha_2 age + \alpha_3 education + \alpha_4 professional\ statut + \alpha_5 marital\ statut \\
& + \alpha_6 income + \alpha_7 religion + \alpha_8 financial\ knowledge + \alpha_9 vulnerability \\
& + \alpha_{10} formal\ account + \alpha_{11} security + \alpha_{12} utility + \alpha_{13} ease\ of\ use + \varepsilon
\end{aligned}
\tag{2}
$$

$$
\begin{aligned}
payment = \; & \alpha_0 + \alpha_1 gender + \alpha_2 age + \alpha_3 education + \alpha_4 professional\ statut + \alpha_5 marital\ statut \\
& + \alpha_6 income + \alpha_7 religion + \alpha_8 financial\ knowledge + \alpha_9 vulnerability \\
& + \alpha_{10} formal\ account + \alpha_{11} security + \alpha_{12} utility + \alpha_{13} ease\ of\ use + \varepsilon
\end{aligned}
\tag{3}
$$

$$
\begin{aligned}
saving = \; & \alpha_0 + \alpha_1 gender + \alpha_2 age + \alpha_3 education + \alpha_4 professional\ statut + \alpha_5 marital\ statut \\
& + \alpha_6 income + \alpha_7 religion + \alpha_8 financial\ knowledge + \alpha_9 vulnerability \\
& + \alpha_{10} formal\ account + \alpha_{11} security + \alpha_{12} utility + \alpha_{13} ease\ of\ use + \varepsilon
\end{aligned}
\tag{4}
$$

After each estimation, a post estimation LROC test or good prediction test of the model is performed to check the prediction quality of the model. The second method is an extension of the previous analysis. It consists in estimating a multivariate Probit model. This method takes into account not only the dichotomous nature of the dependent variables but also the interdependence that may exist between the different uses. For it is likely that there is an interdependent relationship between sending money, receiving money, paying money or saving money. In this case, the estimation of the independent models would produce biased coefficients. Consider Sending*, Receiving*, Paying* and Saving*, four latent variables representing the probability of an individual using different MFS. These variables are determined by a set of observable characteristics X. Thus, we can apply the general multivariate Probit specification of Greene (2003) to a Probit in the form of a four-equation system such that:

$$
\begin{cases}
sending_i = \begin{cases} 1\ if\ sending_i^* > 0 \\ \quad 0\ if\ not \end{cases} & with \quad sending_i^* = \beta_E X + \varepsilon_{iE} \\[2ex]
receiving_i = \begin{cases} 1\ if\ receiving_i^* > 0 \\ \quad 0\ if\ not \end{cases} & with \quad receiving_i^* = \beta_R X + \varepsilon_{iR} \\[2ex]
Payment_i = \begin{cases} 1\ if\ Payment_i^* > 0 \\ \quad 0\ if\ not \end{cases} & with \quad Payment_i^* = \beta_P X + \varepsilon_{iP} \\[2ex]
saving_i = \begin{cases} 1\ if\ saving_i^* > 0 \\ \quad 0\ if\ not \end{cases} & with \quad saving_i^* = \beta_S X + \varepsilon_{iS}
\end{cases}
\tag{5}
$$

With i = 1, 2,...n ; X the vector of explanatory variables; $\beta_E, \beta_R, \beta_P\ et\ \beta_S$ parameters to be estimated and $\varepsilon_E, \varepsilon_R, \varepsilon_P\ et\ \varepsilon_S$ the error terms that are assumed to follow a normal distribution. The specificity of this model is that it takes into consideration not only the fact that the different uses of MFS can occur simultaneously, but also the correlation that may exist between the error terms of these equations. It is assumed that the error terms of the four equations constituting the model ($\varepsilon_E, \varepsilon_R, \varepsilon_P\ et\ \varepsilon_S$)are identically distributed and follow a multivariate normal distribution.

This four-equation simultaneous system is estimated by the maximum likelihood simulation (MLS) method.

In these models of MFS utilization, we suspect that the variable that measures MFS ease of use is endogenous because of the presence of unobservable factors in the different utilization equations that are correlated with the ease of use variable. Indeed, there is the possibility of a strong correlation between the ease of use of MFS and the quality of the network (essential for the use of MFS) which may be unobservable in the MFS use equations. The *control function approach* (Awiti 2014) is very often used to correct for this unobserved heterogeneity. Two steps are necessary in this approach: A the first one consists in estimating a selection equation through a discrete choice model. The objective is to calculate the Inverse of the Mills Ration (IRM) from the predicted values of the selection variable. In this study, the selection equation (the selection variable) depends on the MFS operator chosen by individual i. We choose to base the analysis on the operators Orange and MTN Cameroon. This choice is dictated not only by the leading position of these operators on the MFS market in Cameroon, but also by the fact that as cell phone operators, they benefit from a network coverage that is essential for the use of MFS. Considering each operator, the selection equation is as follows:

$$useO_i^* = X_i\beta + Q_i\gamma + \mu_{1i} \tag{6}$$

$$useMTN_i^* = X_i\beta + Q_i\gamma + \mu_{2i} \tag{7}$$

Where $UtilisationO_i^*$ and $UtilisationMTN_i^*$ r represent, respectively, the latent variables of MFS utilization for Orange and MTN Cameroon. Thus, we can write:

$$useO_i^* = \begin{cases} 1 \text{ if individual } i \text{ chooses the operator Orange} \\ 0 \text{ if not} \end{cases} \tag{8}$$

$$useMTN_i^* = \begin{cases} 1 \text{ if individual } i \text{ chooses the operator MTN} \\ 0 \text{ if not} \end{cases} \tag{9}$$

The equation for ease of use is given by:

$$EU_i = X_i\beta + Q_i\gamma + \mathcal{E}_i \tag{10}$$

X_i being the matrix of the other determinants (apart from the ease of use), EU_i the ease of use, and Q_i the matrix of assumed instruments of the relevant[4]. β and γ the parameter vectors associated with X_i and Q_i respectively. μ_{1i}, μ_{2i} and $\mathcal{E}_i$ the error terms. The second step in the approach is to add (as additional explanatory variables) the IRM calculated from the above equations into the utilization equations. The utilization equation taking into account the IRM can thus be presented as follows:

$$use_{ji} = X_i\beta + \rho\hat{\mathcal{E}}_i + \varphi(\hat{\mathcal{E}}_i \times EU_i) + \delta IRM_i + \vartheta_{ji} \tag{11}$$

Where use_{ji} is the use of MFS *j (j : 0=sending ; 1=receiving ; 2=payment ; 3=saving)* by individual *i*. $\hat{\mathcal{E}}_i$ represents the estimated residuals from the ease-of-use equation, a variable potentially endogenous to MFS use. To simplify the analysis, we assumed that ease of use is the only endogenous variable in the use model. $\hat{\mathcal{E}}_i \times EU_i$ is the Inverse of the Mills Ratio

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[4] Based on our empirical investigations, the MFS knowledge variable is used as an additional variable in the selection equations.

obtained in the first step. The significance of the parameter δ thus allows us to make a statement about the existence of unobserved heterogeneities. Controlling for the interaction term $\hat{\varepsilon}_i \times EU_i$ in the reduced-form equation (11) thus corrects for the endogeneity of the usability due to unobserved heterogeneities, in the event that they exist. $\hat{\varepsilon}_i$, the estimated residuals of the MFS usability equation, together with $\hat{\varepsilon}_i \times EU_i$ and IRM form the control function factors for capturing unobserved heterogeneities (Baye and Sitan, 2016).

4. Results and discussion

The LROC tests performed after the estimation of the models will confirm the good predictive quality of these models: the area under the curve is equal to 0.814 for the estimation of sending, 0.793 for receiving, 0.727 for paying and 0.799 for saving (Appendix).Tables II and III show similar results, demonstrating the robustness of the analytical methods adopted and the results obtained. These results show that: the probability of receiving money by cell phone is higher among women; the probability of using all MFS is higher among individuals with a formal account and those with financial knowledge. According to the first result, MFS may be the most convenient way to send money to women given their high exclusion from the traditional financial system[5]. Thus, this high probability of receiving money by cell phone could be explained by the frequent transfers very often intended to satisfy other family needs. A similar result is found in the work of Fall *et al.* (2020) who conclude that women are more likely to use MFS in Senegal. An explanation for the second result could be that, in the Cameroonian financial ecosystem, various MFS are offered by formal financial institutions, in partnership with cell phone operators. Thus, being a customer of these institutions allows one to have information on these offers, and consequently increases the chances of using these services. A similar result is found in Kenya by Jack and Suri (2011) who find an increase in M-Pesa use among people with a formal account.

In contrast, age and employment status exert a negative discriminatory effect on the likelihood of using MFS. In other words, older people are less likely to send money by cell phone, to receive money by cell phone or to save money. This result could be explained by the low penetration of ICT among this category of the population, which, unlike young people, is somewhat resistant to new technologies. The work of Douanla *et al.* (2022) finds a negative effect of age on the probability of sending and receiving money by mobile in Cameroon. The finding on the low probability of use among the unemployed and apprentices reflects the need for a source of income to use MFS. Indeed, the use of these services often involves high costs, which may represent a barrier for people with no income or low income. The analysis of functional and extra-functional variables shows that: individuals who perceive FMS as useful, easy to use and secure are more likely to use MFS. Several works also lead to the positive influence of these variables on the likelihood of MFS usage: While Yu (2012) emphasizes the importance of ease of use in mobile banking usage behavior, Shaikh and Karjaluoto (2015) find that perceived usefulness represents the most important factor of MFS usage behavior in both developed and developing countries.

Table II: Results of the estimation of the Logit model representing the use of MFS

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[5] According to our survey data, women represent only 41% of bank account holders.

Variable	Sending	Receiving	Payment	Saving
	Odds Ratio (Std.err)	Odds Ratio (Std.err)	Odds Ratio (Std.err)	Odds Ratio (Std.err)
Constant	0,104 (0,179)	1,116 (1,849)	0,163 (0,246)	4,587 (8,012)
Women	0,936 (0,137)	1,508*** (0,226)	0,947 (0,126)	1,019 (0,157)
Men	Ref	Ref	Ref	Ref
Age	0,979* (0,010)	0,979* (0,010)	0,996 (0,009)	0,978* (0,011)
Not in school	1,481 (1,534)	0,651 (0,577)	1,422 (1,195)	4,842 (6,906)
Primary	0,731 (0,271)	0,681 (0,242)	0,510** (0,167)	0,614 (0,231)
Secondary	0,821 (0,147)	0,993 (0,177)	0,811 (0,128)	0,665** (0,123)
Higher education	Ref	Ref	Ref	Ref
Unemployed	0,337*** (0,090)	0,696 (0,190)	0,951 (0,233)	0,553** (0,158)
Apprentice	0,309*** (0,075)	0,579** (0,137)	0,684* (0,144)	0,383*** (0,098)
Retired	0,622 (0,397)	0,419 (0,254)	0,838 (0,478)	0,272** (0,172)
Employee	Ref	Ref	Ref	Ref
Couple	1,360 (0,302)	1,292 (0,280)	1,319 (0,253)	1,087 (0,245)
Divorced/widowed	1,743 (0,888)	1,292 (0,657)	1,292 (0,568)	2,553 (1,522)
Single	Ref	Ref	Ref	Ref
No religion	0,597 (0,238)	0,722 (0,281)	0,994 (0,357)	0,573 (0,246)
Christian	0,812 (0,197)	1,020 (0,245)	0,871 (0,190)	0,601 (0,164)
Muslim	Ref	Ref	Ref	Ref
Income	0,953 (0,136)	0,763* (0,107)	0,956 (0,122)	0,710** (0,104)
Financial Knowledge	1,872** (0,584)	1,912** (0,588)	1,981** (0,584)	1,642 (0,532)
Vulnerability	0,887 (0,129)	1,120 (0,167)	0,882 (0,118)	1,071 (0,165)
Formal account	1,966*** (0,403)	2,255*** (0,468)	1,615*** (0,286)	2,174*** (0,470)
Security	1,475*** (0,215)	1,556*** (0,230)	1,354** (0,179)	1,330* (0,204)
usefulness	13,721*** (5,496)	8,079*** (2,819)	4,158*** (1,367)	9,632*** (3,587)
Ease of use	4,869*** (1,895)	4,217**** (1,478)	2,834*** (0,942)	7,981*** (3,044)
Number of observations =	1200	1200	1200	1200
LR chi2 (19) =	431,01	387,25	222,87	453,75
Prob > chi2 =	0,0000	0,0000	0,0000	0,0000
Pseudo R2 =	0,2656	0,2457	0,1360	0,2900

Source: based on survey data. Note: *** significant at 1%; ** significant at 5%; * significant at 10.

Table III: Results of the estimation of the multivariate Probit model

Variable	Sending (1)	Receiving (2)	Payment (3)	Saving (4)
	Coef	Coef	Coef	Coef
	(Std.err)	(Std.err)	(Std.err)	(Std.err)
Constant	-1,195	-0,339	-1,131	0,521
	(1,003)	(0,954)	(0,895)	(1,006)
Women	-0,056	0,260***	0,001	0,032
	(0,86)	(0,084)	(0,079)	(0,086)
Men	Ref	Ref	Ref	Ref
Age	-0,012**	-0,014**	-0,003	-0,014**
	(0,006)	(0,006)	(0,005)	(0,006)
Not in school	0,229	-0,290	0,189	0,963
	(0,531)	(0,495)	(0,479)	(0,938)
Primary	-0,210	-0,158	-0,349*	-0,227
	(0,215)	(0,210)	(0,197)	(0,220)
Secondary	-0,117	0,031	-0,121	-0,218**
	(0,104)	(0,101)	(0,094)	(0,104)
Higher education	Ref	Ref	Ref	Ref
Unemployed	-0,635***	-0,193	-0,045	-0,341**
	(0,157)	(0,155)	(0,147)	(0,162)
Apprentice	-0,665***	-0,290**	-0,244**	-0,542***
	(0,138)	(0,132)	(0,125)	(0,142)
Retired	-0,161	-0,394	-0,023	-0,629
	(0,391)	(0,364)	(0,345)	(0,401)
Employed	Ref	Ref	Ref	Ref
Couple	0,218*	0,145	0,162	0,039
	(0,131)	(0,123)	(0,114)	(0,126)
Divorced/widowed	0,234	0,021	0,081	0,368
	(0,277)	(0,278)	(0,253)	(0,297)
Single	Ref	Ref	Ref	Ref
No religion	-0,361	-0,148	0,031	-0,293
	(0,229)	(0,223)	(0,209)	(0,243)
Christian	-0,112	0,045	-0,058	-0,271
	(0,141)	(0,138)	(0,130)	(0,151)
Muslim	Ref	Ref	Ref	Ref
income	-0,038	-0,123	-0,018	-0,175***
	(0,083)	(0,080)	(0,075)	(0,084)
Financial Knowledge	0,385**	0,394**	0,398**	0,277
	(0,179)	(0,175)	(0,174)	(0,182)
Vulnerability	-0,040	0,084	-0,056	0,062
	(0,085)	(0,084)	(0,079)	(0,086)
Formal account	0,350***	0,468***	0,292***	0,444***
	(0,116)	(0,115)	(0,104)	(0,118)
Security	0,189**	0,231***	0,164**	0,121
	(0,085)	(0,083)	(0,078)	(0,086)
Usefulness	1,494***	1,253***	0,883***	1,371***
	(0,212)	(0,205)	(0,197)	(0,212)
Ease of use	0,966***	0,822***	0,583***	1,296***
	(0,217)	(0,210)	(0,200)	(0,220)

Number obs =	1200	Likelihood ratio test of rho21 = rho31 = rho41 = rho32 = rho42 =
Wald chi2 (76) =	590,03	rho43 = 0 rho21= 0,690*** (0,033); rho31= 0,483*** (0,040);
Prob > chi2 =	0,0000	rho41= 0,615*** (0,039); rho32= 0,462*** (0,041); rho42=
		0,633*** (0,035); rho43= 0,397*** (0,045).

Source: based on survey data. Note: *** significant at 1%; ** significant at 5%; * significant at 10.

Tables IV and V present the results of correcting for potential sample selection bias and unobserved heterogeneity captured by the interaction between ease of use and its residual, for Orange and MTN FMS users respectively. When we focus on the Orange MFS, the IRM confirms the existence of heterogeneity in the analysis of MFS use: the coefficients associated with the MRI are significant at the 1% level for all these services. For the mobile remittance, the analysis reveals that employment status, gender, and perceived usefulness have a negative discriminatory effect on the likelihood of sending remittances, while formal account ownership and perceived security positively affect this likelihood. The control function approach leads to a positive effect of the variables possession of a formal account and perceived security on the probability of receiving money from the Orange operator, while perceived usefulness negatively affects this same probability. As for mobile payments, we find that their use depends on a high level of education, highlighting the importance of cognitive factors in the use of technological innovations: people who cannot read or write would have more difficulty using MFS-related instruments, and would therefore tend to reject them.

Table IV: Correction of unobserved heterogeneity: the case of the use of Orange MFS

Variable	Selection	Sending	Receiving	Payment	Saving
	Coef (Err.type)	Coef (Err.type)	Coef (Err.type)	Coef (Err.type)	Coef (Err.type)
Constant	0,635 (0,982)	-3,823*** (1,188)	-1,905* (1,147)	-2,322** (1,081)	-2,041* (1,204)
Women	-0,115 (0,086)	-0,166* (0,0934)	0,141 (0,0930)	-0,109 (0,0871)	-0,150 (0,0965)
Age	0,016*** (0,006)	0,0114 (0,00841)	0,00559 (0,00827)	0,0102 (0,00747)	0,0139 (0,00863)
Not in school	-0,041 (0,547)	0,212 (0,610)	-0,267 (0,532)	0,218 (0,498)	0,848 (0,770)
Primary	0,079 (0,218)	-0,182 (0,222)	-0,216 (0,217)	-0,406** (0,207)	-0,272 (0,225)
Secondary	0,153 (0,101)	0,0761 (0,117)	0,153 (0,116)	-0,0269 (0,107)	-0,0148 (0,118)
Unemployed	0,037 (0,162)	-0,596*** (0,156)	-0,186 (0,158)	-0,0199 (0,149)	-0,311* (0,164)
Apprentice	0,120 (0,137)	-0,362** (0,156)	-0,0718 (0,154)	-0,0681 (0,144)	-0,202 (0,163)
Retired	-0,247 (0,356)	-0,517 (0,370)	-0,694* (0,357)	-0,236 (0,354)	-1,116*** (0,395)
Couple	-0,132 (0,122)	0,0221 (0,136)	0,0306 (0,131)	0,0863 (0,122)	-0,126 (0,137)
Divorced/ widowed	-0,132 (0,274)	0,163 (0,283)	0,0556 (0,290)	0,0863 (0,262)	0,364 (0,316)
No religion	0,207 (0,237)	-0,187 (0,247)	-0,0800 (0,242)	0,0886 (0,222)	-0,104 (0,260)
Christian	0,246** (0,146)	0,0273 (0,169)	0,127 (0,166)	0,0184 (0,153)	-0,0745 (0,180)
Income	0,020 (0,082)	0,0558 (0,0874)	-0,0875 (0,0860)	0,00998 (0,0809)	-0,0920 (0,0887)
Financial Knowledge	-0,113 (0,194)	0,116 (0,198)	0,199 (0,194)	0,292 (0,188)	-0,000344 (0,202)
Vulnerability	0,088 (0,086)	-0,0856 (0,108)	0,0620 (0,108)	-0,0625 (0,101)	0,0435 (0,111)

Formal account	-0,049	0,254**	0,372***	0,218**	0,292**
	(0,114)	(0,122)	(0,122)	(0,110)	(0,125)
Security	-0,054	0,224**	0,245***	0,166**	0,152
	(0,086)	(0,0904)	(0,0898)	(0,0845)	(0,0931)
Usefulness	-1,901***	-4,649***	-2,924**	-1,951	-4,954***
	(0,129)	(1,549)	(1,453)	(1,408)	(1,548)
MFS Knowledge	-0,346***				
	(0,123)				
Residence		5,678***	3,997**	2,502	5,386***
		(1,772)	(1,650)	(1,575)	(1,778)
Interaction		0,326	0,147	0,203	0,730**
		(0,291)	(0,299)	(0,286)	(0,286)
IRM		1,644***	1,244***	0,950***	1,894***
		(0,477)	(0,476)	(0,448)	(0,487)
Number of observations =	1200	1200	1200	1200	1200
Prob > chi2 =	0,0000	0,0000	0,0000	0,0000	0,0000
Pseudo R2 =	0,2336	0,2685	0,2440	0,1349	0,2922

Source: based on survey data. Note: *** significant at 1%; ** significant at 5%; * significant at 10.

Table V: Correction of unobserved heterogeneity: the case of the use of MTN MFS

Variable	Selection	Sending	Receiving	Payment	Saving
	Coef	Coef	Coef	Coef	Coef
	(Err.type)	(Err.type)	(Err.type)	(Err.type)	(Err.type)
Constant	0,706	-4,572***	-2,285*	-2,225**	-2,073*
	(0,936)	(1,211)	(1,175)	(1,114)	(1,220)
Women	0,0422	0,0210	0,271***	-0,0225	0,0431
	(0,0811)	(0,0884)	(0,0882)	(0,0818)	(0,0904)
Age	0,000996	-0,00481	-0,00640	0,00144	-0,00567
	(0,00591)	(0,00673)	(0,00664)	(0,00597)	(0,00687)
Not in school	-0,995**	-0,986	-1,129*	-0,0964	0,0942
	(0,489)	(0,737)	(0,623)	(0,554)	(0,936)
Primary	-0,146	-0,450**	-0,414*	-0,526**	-0,531**
	(0,209)	(0,224)	(0,218)	(0,206)	(0,226)
Secondary	-0,121	-0,248**	-0,0731	-0,170*	-0,332***
	(0,0962)	(0,110)	(0,108)	(0,0990)	(0,111)
Unemployed	0,374**	-0,166	0,0862	0,102	-0,00243
	(0,150)	(0,185)	(0,186)	(0,176)	(0,192)
Apprentice	0,350***	-0,0265	0,131	-0,00680	-0,0144
	(0,128)	(0,185)	(0,182)	(0,173)	(0,190)
Retired	0,182	0,0334	-0,334	-0,0498	-0,663*
	(0,363)	(0,379)	(0,365)	(0,359)	(0,402)
Couple	0,138	0,361***	0,262**	0,222*	0,182
	(0,113)	(0,137)	(0,131)	(0,122)	(0,135)
Divorced/widowed	0,254	0,627**	0,365	0,241	0,754**
	(0,262)	(0,296)	(0,302)	(0,272)	(0,330)
No religion	-0,413*	-0,869***	-0,537**	-0,155	-0,699***
	(0,231)	(0,261)	(0,250)	(0,230)	(0,267)
Christian	-0,325**	-0,604***	-0,306*	-0,231	-0,650***
	(0,142)	(0,169)	(0,165)	(0,154)	(0,178)
Income	0,117	0,182*	-0,00802	0,0418	-0,00520
	(0,0784)	(0,0931)	(0,0915)	(0,0863)	(0,0943)
Financial Knowledge	0,0967	0,353*	0,351*	0,389**	0,213
	(0,186)	(0,200)	(0,194)	(0,188)	(0,201)
Vulnerability	-0,121	-0,353***	-0,125	-0,179*	-0,209*
	(0,0817)	(0,105)	(0,105)	(0,0991)	(0,108)

Formal account	-0,306***	-0,0799	0,167	0,137	0,0735
	(0,106)	(0,152)	(0,149)	(0,138)	(0,154)
Security	0,118	0,442***	0,395***	0,249***	0,336***
	(0,0812)	(0,0960)	(0,0951)	(0,0891)	(0,0976)
Usefulness	-1,352***	-4,544***	-2,748*	-1,480	-4,166***
	(0,154)	(1,513)	(1,420)	(1,373)	(1,500)
MFS Knowledge	-0,502***				
	(0,130)				
Residence		6,262***	4,490***	2,730*	5,817***
		(1,775)	(1,654)	(1,575)	(1,773)
Interaction		0,315	0,148	0,220	0,745***
		(0,292)	(0,299)	(0,286)	(0,286)
IRM		2,119***	1,371***	0,623	1,581***
		(0,473)	(0,467)	(0,442)	(0,477)
Number of observations =	1200	12000	1200	1200	1200
Prob > chi2 =	0,0000	0,0000	0,0000	0,0000	0,0000
Pseudo R2 =	0,1234	0,2736	0,2451	0,1334	0,2896

Source: based on survey data. Note: *** significant at 1%; ** significant at 5%; * significant at 10.

Considering the use of MTN's MFS, it is also possible to confirm the existence of heterogeneity in the sending, receiving and saving. A comparative analysis of the explanatory factors of FMS use reveals a differentiated influence depending on whether individuals choose to use the services of the Orange or MTN operator. Indeed, if socio-professional status and perceived usefulness are the only variables reducing the chances of sending with Orange, the chances of sending with MTN are reduced by many more factors, in particular the level of education (implying the importance of cognitive factors in the use of FMS and could at the same time reflect a greater difficulty in using the MTN service compared to that of Orange), religious affiliation, vulnerability (which could reflect the higher cost of the service at MTN and therefore the difficulty of use for vulnerable people) and perceived usefulness. This trend is also observed for mobile savings, where many more variables have a negative discriminatory effect on the MTN operator (notably low level of education, socio-professional status, religious affiliation, and vulnerability).

5. Conclusion

The objective of this study was to analyze the explanatory factors of MFS use in the city of Yaoundé, relying first on logistic regressions, then on a multivariate Probit under the assumption of interdependence to check the robustness of the results, and finally, on the control function method to correct for unobserved heterogeneity in the use equation. The results of the logistic and multivariate regressions reveal that women are more likely to receive money via mobile while the odds of sending, receiving and saving are reduced among the elderly. Also, the analysis by education level reveals a low probability of mobile payment and saving among people with low education level. The control function approach shows that many more variables have a negative discriminatory effect on the probability of using MTN's MFS, whether it is sending, receiving or saving mobile money. The negative influence of primary and secondary education levels on the probability of sending and saving with MTN could suggest that these services are more difficult to use (because they require a higher level of education) with MTN than with its competitor. Also, the low probability of mobile sending and saving among

vulnerable people with MTN could reflect the higher cost of these services with MTN, making them more difficult to use for vulnerable people.

These results are of particular importance for the design of strategies to improve or encourage the use of MFS. Indeed, despite the many recognized benefits of MFS, this study shows that there are still many barriers to the use of these services. These barriers are linked to both the characteristics of the individuals and the characteristics of these services. This is the case for the absence or insufficiency of cognitive skills, which in this work is reflected in a low probability of using MFS among individuals who have not attended school or, in general, among people with a low level of education. To address this obstacle, action by MFS operators could be directed towards financial education of the groups of individuals concerned, through intensified campaigns aimed not only at raising awareness of MFS, but above all at educating these individuals about the various uses: the aim here is to improve understanding of how MFS work in order to facilitate their use by these groups. The analyses also reveal that older people are less likely to use MFS than younger people. This result highlights the somewhat resistant nature of the older cohorts to technological and financial innovations due not only to the low penetration of ICT among these groups, but also to the difficulties in using the technology. In relation to this result, an action of the MFS operators would also be to popularize these services within the groups concerned, to improve the understanding of its functioning in order to facilitate its use. Another result of this study is that individuals with access to banking services (i.e., those with an account at a formal financial institution) are more likely to use MFS. One recommendation that can be derived from this result is the need for banking institutions to further develop MFS in order to increase the intensity of use by banked individuals. It would therefore be appropriate for these institutions to expand the range of MFS offered to their clients. For example, this could involve developing mobile pension payment services for retired civil servants, as well as microcredit or loan repayments via mobile.

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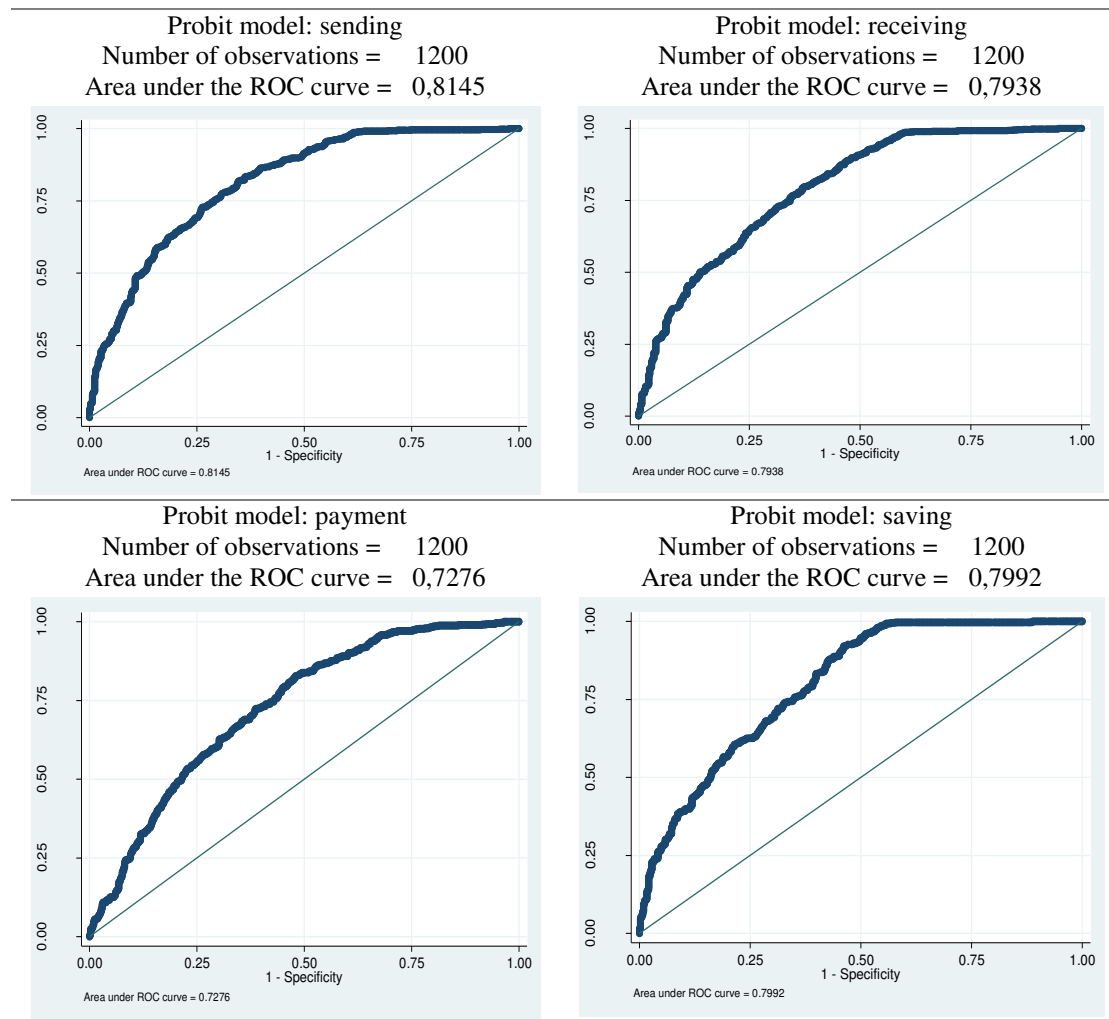
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Appendix

Figure I: LROC post estimation test of the Logit model of MFS use

Source: Based on survey data.