

# Digital Financial Inclusion in WAEMU: Socio-Demographic Factors Associated with Mobile Money Adoption

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**Abstract :** *This paper examines socio-economic factors associated with digital financial inclusion in WAEMU region, using harmonized household survey data. A logit model is estimated to analyze individual-level mobile money adoption across the eight WAEMU countries. The results indicate that access to electricity, internet connectivity, education, and employment are positively associated with mobile money adoption, while mobile money use tends to complement formal bank account ownership. These findings have implications for ongoing initiatives aimed at strengthening interoperability among financial service providers. This paper contributes to the literature in three ways. First, it provides harmonized micro-level evidence on mobile money adoption covering all WAEMU countries, whereas most existing studies focus on individual countries. Second, it combines individual-level estimation with cluster-level robustness analyses using alternative econometric approaches. Third, it provides policy-relevant insights for regional financial inclusion strategies in the WAEMU context.*

**Keywords:** *Mobile money, Digital financial inclusion; Financial access, WAEMU, Household survey.*

**JEL Classification:** *O16, G21, O55.*

## 1. Introduction

Financial inclusion, defined as access by individuals and firms to useful and affordable financial products and services, is regarded by the World Bank as a key driver of economic growth and poverty reduction in developing countries. In the West African Economic and Monetary Union (WAEMU), this issue has been placed high on the policy agenda, notably through the adoption of a regional financial inclusion strategy aimed at expanding access to formal financial services.

With the rapid advancement of information and communication technologies (ICT), mobile banking services, electronic wallets (mobile money), and online payment platforms have transformed access to financial services in the region. By enabling broader participation in the digital economy, these financial innovations offer an effective alternative to the traditional constraints of conventional financial services, notably the limited physical presence of banking institutions and high transaction costs. As a result, the number of users of digital financial services has increased substantially in the WAEMU region in recent years, driven in particular by the rapid expansion of mobile money.

According to the Centrale Bank (BCEAO) report on digital financial services, the number of electronic money accounts in the WAEMU reached 131 million in 2021, representing a 39 percent increase compared to 2020, equivalent to 37 million newly registered accounts. The total number of transactions rose to 5 billion in 2021, up from 4 billion in 2020, corresponding to a 47 percent increase. Similarly, the total value of transactions increased by 54 percent, reaching CFA 63,895 billion compared to CFA 41,455 billion in 2020. All WAEMU countries recorded an increase in transaction values, with Côte d'Ivoire and Senegal accounting for 60.9 percent of the total transaction value, followed by Burkina Faso (14.71 percent), Mali (10.81 percent), and Benin (9.58 percent). Togo, Niger, and Guinea-Bissau recorded relatively low shares, at 3.04 percent, 0.54 percent, and 0.44 percent respectively (BCEAO, 2023).

Against this background, this paper analyzes the socio-economic and demographic factors associated with mobile money adoption in WAEMU countries using micro-level data from the Harmonized Survey on Household Living Conditions (EHCVM). A binary logit model estimated at the individual level is employed, complemented by alternative specifications, including generalized estimating equations (GEE), fractional logit, and a Mundlak correlated random effects approach at the cluster level, to assess robustness. The paper contributes to the literature by providing harmonized microeconomic evidence covering all WAEMU countries and by offering policy-relevant insights for the design of digital financial inclusion strategies. The remainder of the paper is organized as follows: Section 2 reviews the literature, Section 3 presents the data and methodology, Section 4 reports the empirical results, and Section 5 discusses policy implications.

## **2. Literature Review**

After defining the key concepts, this section provides a brief review of the literature on digital financial inclusion.

### **2.1. Digital financial inclusion: concepts and measurement**

This subsection clarifies the concepts of financial inclusion and digital financial inclusion, which constitute the two main concepts underlying the study.

#### **❖ Financial inclusion**

According to the World Bank, financial inclusion refers to the ability of individuals and firms to access a wide range of financial products and services (such as transactions, payments, savings, credit, and insurance) that are affordable, useful, and tailored to their needs, and provided by reliable and responsible institutions. It is also defined as the provision of financial services adapted to populations excluded from the traditional financial system, under sustainable conditions for both legally recognized providers and beneficiaries.

Financial inclusion is widely regarded as an important driver of sustainable development. Owing to its multidimensional nature, it constitutes a component of social inclusion, as the efficient use of financial services can facilitate durable access to basic social services, including health, education, and employment. Financial inclusion can strengthen economic activity, mobilize public savings, increase the incomes of economic agents, and support higher social spending on areas such as health and education, thereby contributing to poverty and inequality reduction and promoting sustained and inclusive development (BCEAO, 2018).

In this article, and given the available data, financial inclusion is measured as the proportion of individuals holding at least one account with a bank, a mobile money service, a microfinance institution, or a prepaid card.

#### **❖ Digital financial inclusion**

Digital finance refers to financial services delivered through mobile phones, computers, or cards connected to a reliable digital payment system. It includes the products, services, technologies, and infrastructures that enable individuals and firms to access payments, savings,

and credit through digital channels without necessarily visiting a bank branch. Digital financial inclusion emphasizes the role of technology in expanding access to formal financial services and reflects recent changes in the delivery of financial services based on digital infrastructures (Lee-Ying, 2022).

In practice, digital financial inclusion relies on several complementary components, including digital devices, a network of retail agents facilitating transactions and cash–electronic money conversion, and financial services provided by banks, non-bank institutions, and FinTech firms (Peterson, 2022).

In this study, digital financial inclusion is measured as the proportion of individuals holding a mobile money account. This choice reflects the fact that, within the WAEMU, mobile money is the most widespread and accessible digital financial service, particularly in a context of low banking penetration.

Digital financial inclusion, and more specifically mobile money adoption, has been the subject of extensive empirical literature. Several studies highlight that adoption depends on a combination of individual characteristics (income, education, gender), technological factors (infrastructure and connectivity), and the broader institutional and banking environment.

A first widely studied determinant is income level. Analyses based on the Global Findex database (Demirgüç-Kunt & Klapper, 2012; Allen et al., 2016) show that higher-income households are more likely to adopt digital financial services, as they possess both the financial capacity to acquire the necessary tools (such as mobile phones and internet access) and the ability to bear transaction costs. Conversely, low-income households face persistent financial barriers that limit their inclusion (Pazarbasioglu et al., 2020). This relationship suggests that affordability remains a major constraint for the expansion of mobile money, particularly in rural areas.

Access to telecommunications infrastructure also constitutes a key enabling condition. The pioneering study by Aker and Mbiti (2010) showed that the diffusion of mobile phones in Sub-Saharan Africa significantly transformed economic behavior, with network coverage emerging as a major driver of digital service adoption. These findings are confirmed by Zins and Weill (2016), who, using data from the 2014 Global Findex, show that the expansion of telecommunications and internet networks is positively associated with the use of mobile money. Digital infrastructure thus appears as a catalyst for financial inclusion, although it may also reinforce disparities between urban and rural areas.

Education and financial literacy also play an important role in adoption. Studies by Demirgüç-Kunt and Klapper (2015) and Banerjee and Duflo (2011) show that individuals with higher levels of education are better able to understand financial products and are more likely to adopt mobile money. In addition, Lusardi and Mitchell (2014) emphasize the importance of financial literacy in shaping saving and investment behavior. These studies suggest that beyond the availability of financial services, demand depends strongly on individuals' ability to understand and effectively use these tools, highlighting the importance of financial education programs in developing countries.

Gender disparities constitute another dimension emphasized in the literature. Studies by Demirgüç-Kunt and Klapper (2013) and GSMA reports (2020) show that women remain underrepresented in access to digital financial services due to constraints related to income, education, and social norms. These inequalities limit the potential impact of mobile money on financial inclusion.

Another strand of the literature examines the relationship between traditional banking services and mobile money. Several studies highlight a complementary rather than substitutive relationship. Zins and Weill (2016) find that the factors associated with holding a traditional bank account are similar to those related to mobile money adoption. Similarly, Fall and Birba (2019), using a logit model,

show that bank account ownership significantly increases the probability of using mobile money. These findings are confirmed by Khera et al. (2021), who suggest that mobile money tends to expand in contexts where banking services are limited but where individuals are already familiar with basic financial services. This dynamic reflects both substitution effects (in areas with limited banking coverage) and complementarity effects (in more banked environments).

Finally, several studies have examined the effects of mobile money adoption on household welfare. Kikulwe et al. (2014), using panel data on Kenyan farming households, show that mobile money has a positive impact on the income of smallholder farmers by facilitating remittance transfers and improving access to agricultural inputs. These findings suggest that digital financial inclusion extends beyond financial access and can generate direct benefits in terms of productivity, resilience, and poverty reduction.

Overall, the empirical literature highlights several factors associated with mobile money adoption, including individual characteristics (income, education, gender), technological factors (infrastructure and network coverage), and the broader institutional environment (banking penetration and regulatory framework).

### **2.3. Gaps in the literature**

Existing studies on digital financial inclusion tend to focus on a limited number of countries. The available evidence for WAEMU countries remains fragmented and is largely confined to a few countries, particularly Côte d'Ivoire and Senegal. Moreover, some studies rely on aggregated indicators collected from providers of digital financial services, notably electronic money institutions. While informative, these analyses provide only limited insights into the individual determinants of adoption and the socio-economic heterogeneity that characterizes the use of mobile money.

Furthermore, few studies explicitly examine, within the WAEMU context, the relationship between mobile money adoption and access to formal financial services. The question of whether mobile money acts as a substitute for traditional banking services or rather complements them remains largely unresolved from an empirical perspective. Yet, this issue is of particular relevance for policymakers and regulatory authorities seeking to design coherent strategies that promote both digital financial inclusion and the strengthening of the formal financial system.

This paper seeks to address these gaps by providing a microeconomic analysis based on household survey data using a harmonized methodology covering all eight WAEMU countries. By focusing on individual mobile money adoption and its relationship with socio-economic characteristics, the study provides region-specific empirical evidence and contributes to a better understanding of the dynamics of digital financial inclusion in WAEMU. The findings offer useful insights for the design of public policies aimed at promoting financial inclusion in the region.

## **3. Data and Descriptive Statistics**

This section describes the data used in the study and presents descriptive statistics for selected key variables.

### **3.1. Data source and sample**

The data used in this study are drawn from the Harmonized Survey on Household Living Conditions (EHCVM), conducted across all WAEMU countries. The survey was implemented under the coordination of the WAEMU Commission with technical and financial support from the World Bank. Two editions of the EHCVM were carried out in 2018/2019 and 2021/2022. The questionnaire module related to mobile money account ownership is administered exclusively to individuals aged 15 years and above.

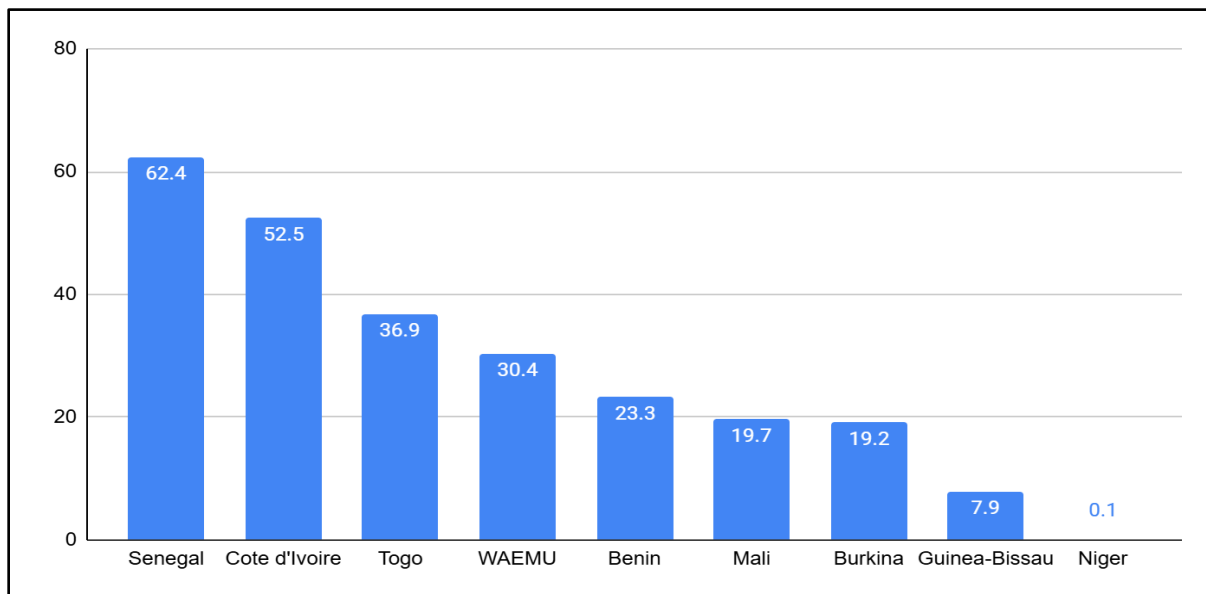
### 3.2. Descriptive statistics

This subsection presents descriptive statistics on financial inclusion, bank account ownership, and mobile money account ownership using data from the second edition of the EHCVM conducted in 2021/2022.

- **Mobile money account ownership**

In 2021, the rate of mobile money account ownership in the WAEMU stood at 30.4 percent. Senegal (62.4 percent) and Côte d'Ivoire (52.5 percent) stand out with particularly high levels, reflecting the widespread diffusion of these services. Togo (36.9 percent) occupies an intermediate position, above the regional average, while Benin (23.3 percent), Mali (19.7 percent), and Burkina Faso (19.2 percent) display more moderate but relatively similar levels. In contrast, Guinea-Bissau (7.9 percent) and especially Niger (0.1 percent) record very low levels, indicating that adoption remains limited.

**Figure 1 : Mobile money account ownership rate by country**



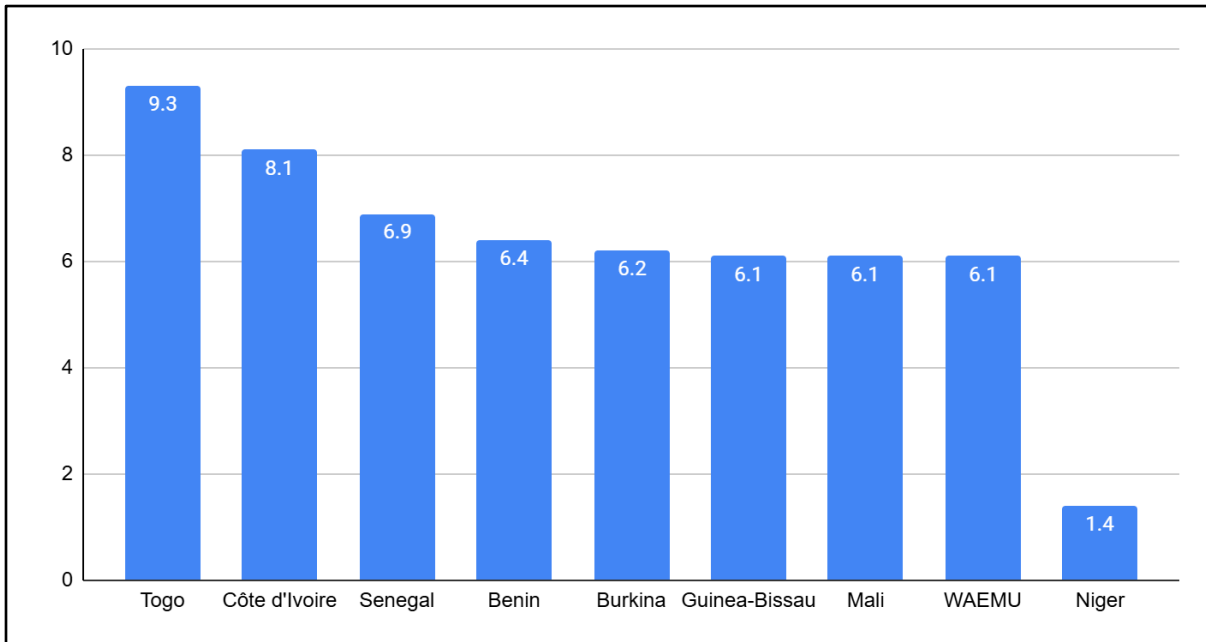
Source: Authors' calculations based on EHCVM 2021/2022.

- ❖ **Bank account ownership**

The rate of bank account ownership in WAEMU stands at 6.1 percent, reflecting the relatively low level of banking penetration among the population. Togo (9.3 percent) and Côte d'Ivoire (8.1 percent) record the highest levels, with adoption rates slightly above the regional average. Senegal (6.9 percent) also stands above the regional mean. In contrast, Benin (6.4 percent), Burkina Faso (6.2 percent), Guinea-Bissau (6.1 percent), and Mali (6.1 percent) report rates very close to the Union's average, indicating a relatively homogeneous pattern of low banking penetration across these countries. Niger (1.4 percent) constitutes an exception, with a particularly low level of access to banking services.

These results indicate that banking penetration remains limited across WAEMU countries, with relatively low levels of bank account ownership in most member states. This situation highlights the importance of alternative channels of financial inclusion, particularly mobile money, which partly compensates for the limited reach of traditional banking services.

**Figure 2 : Bank account ownership rate by country**

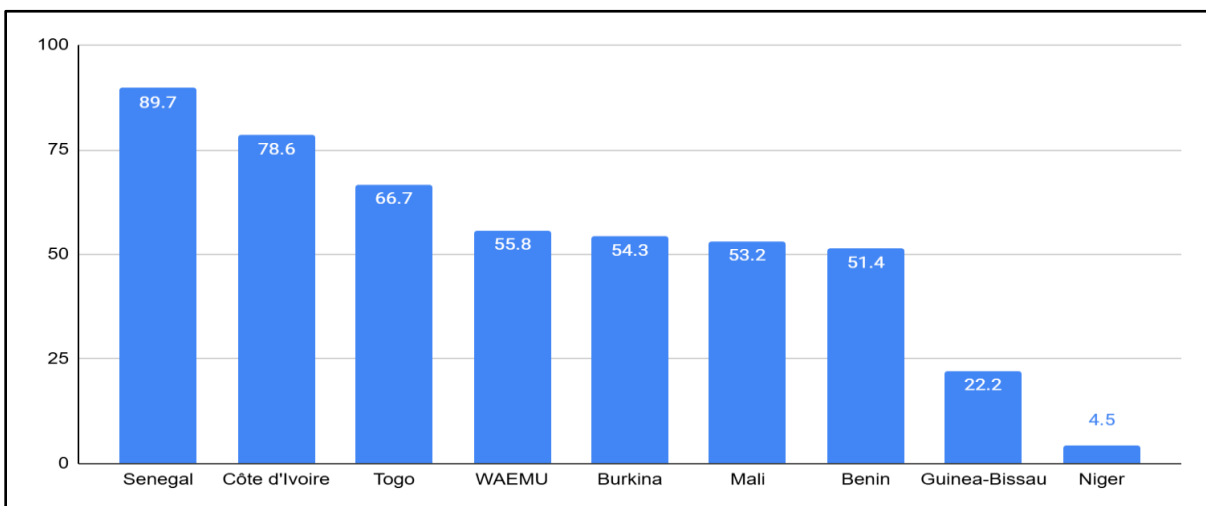


Source: Authors' calculations based on EHCVM 2021/2022.

❖ **Joint ownership of bank accounts and mobile money accounts**

The figure below presents the proportion of individuals holding a mobile money account among those who already have a bank account in WAEMU. At the aggregate level, this proportion stands at 55.8 percent, suggesting the coexistence of traditional banking services and mobile money. The countries recording the highest proportions are Senegal (89.7 percent), Côte d'Ivoire (78.6 percent), and Togo (66.7 percent).

**Figure 3 : Proportion of individuals holding a mobile money account among bank account holders.**

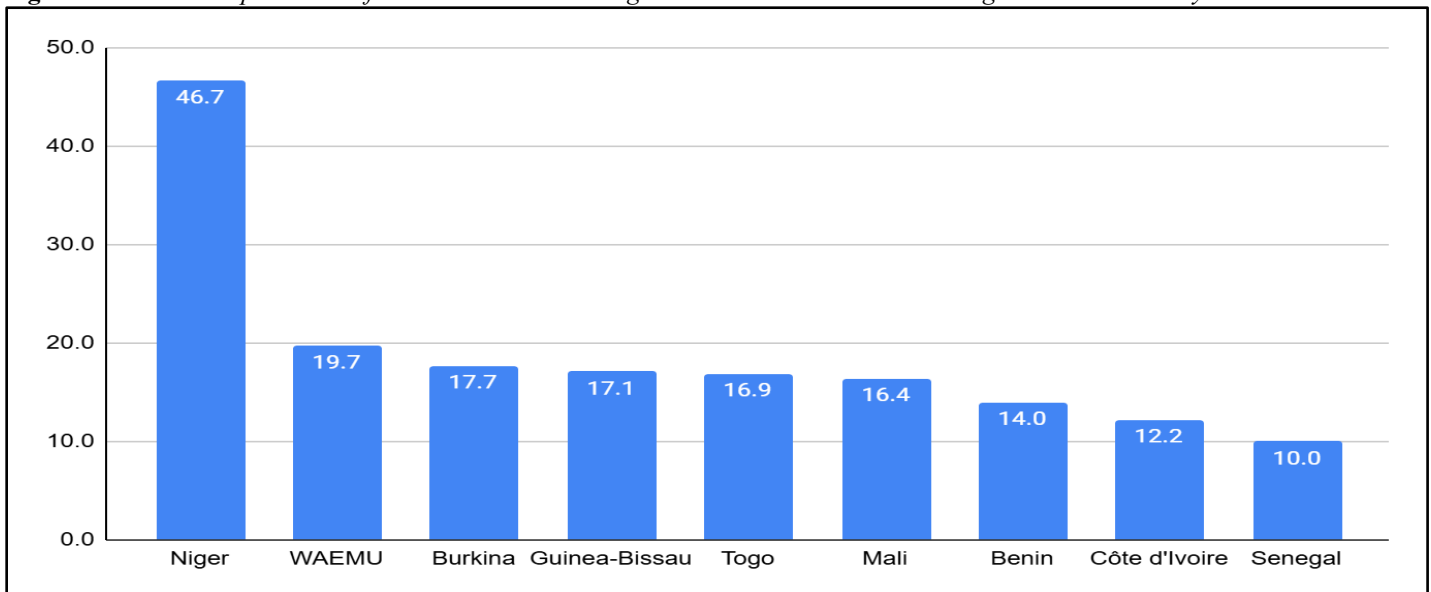


Source: Authors' calculations based on EHCVM 2021/2022.

The figure below presents the proportion of individuals holding a bank account among those who own a mobile money account. This proportion stands at 19.7 percent, indicating that banking penetration remains relatively limited among mobile money users. In other words, the majority of mobile money account holders do not possess a traditional bank account.

Niger (46.7 percent) stands out from the other countries, with a particularly high proportion. This result can be explained by the very limited diffusion of mobile money in the country. In this context, the few mobile money users are largely individuals who are already banked. By contrast, Senegal (10.0 percent) and Côte d'Ivoire (12.2 percent), which record the highest levels of financial inclusion in the Union, display the lowest proportions.

**Figure 4** : *Proportion of individuals holding a bank account among mobile money account holders.*



Source: Authors' calculations based on EHCVM 2021/2022.

The two previous figures provide insights into the relationship between bank accounts and mobile money accounts in WAEMU.

*Mobile money appears to complement traditional banking services.* The first analysis, examining the proportion of mobile money account holders among banked individuals, shows that, at the regional level, more than half of individuals with a bank account also hold a mobile money account (55.8 percent). This suggests that, for individuals already integrated into the banking system, mobile money serves as a complementary and convenient tool for facilitating everyday transactions.

*However, banking penetration among mobile money users remains low.* The second analysis, focusing on the proportion of banked individuals among mobile money account holders, reveals the opposite pattern: only 19.7 percent of mobile money users possess a bank account. In other words, the majority of mobile money users remain outside the traditional banking system. This phenomenon is particularly evident in countries such as Senegal (10 percent) and Côte d'Ivoire (12.2 percent).

Overall, these results indicate that banked individuals widely integrate mobile money into their financial practices, whereas most mobile money users have limited access to traditional banking services. Mobile money therefore appears to act as an entry point for financial inclusion in WAEMU, reaching a much broader population than traditional banks. Nevertheless, a degree of segmentation persists between the two systems, as the use of mobile money does not automatically lead to conventional banking access.

#### 4. Methodology

This section presents the methodology adopted in the study. A baseline model is first estimated, followed by robustness analyses based on alternative model specifications. The baseline model is estimated using data from the second round of the EHCVM, while the alternative models are estimated using the combined data from the two rounds of the survey.

##### 4.1. Baseline binary choice model

The analysis of the socio-economic factors associated with digital financial inclusion is conducted through the estimation of an econometric model for qualitative variables. The dependent variable is mobile money account ownership. It takes the value 1 if the individual owns a mobile money account and 0 otherwise. The explanatory variables include the socio-economic characteristics of individuals. A binary logistic model is estimated, in line with approaches commonly used in the literature for similar studies, notably those of Fall et al. (2019) and Kikulwe et al. (2014).

Logistic regression is appropriate when the objective is to explain a qualitative dependent variable using a set of explanatory variables that may be either qualitative or quantitative. In the present study, the variable of interest is binary, with two possible outcomes. The use of a logit model is therefore justified. In addition, the logit model offers numerical simplicity and produces results that are relatively easy to interpret.

- **Model specification**

Let  $Y_i$  denote the dependent variable, defined as follows:

$$Y_i = \begin{cases} 1, & \text{if individual } i \text{ owns a mobile money account} \\ 0, & \text{otherwise.} \end{cases}$$

To model this decision, it is assumed that individuals are rational and choose to hold a mobile money account if the utility derived from doing so, denoted  $U_i^*$ , exceeds a certain threshold. This utility is an unobservable variable, commonly referred to as a latent variable.

$$Y_i = \begin{cases} 1, & \text{if } U_i^* > \alpha \\ 0, & \text{otherwise.} \end{cases}$$

where the latent variable  $U_i^*$  is specified as:

$$U_i^* = x_i\beta + \epsilon_i$$

Here,  $x_i$  represents the vector of observable characteristics of individual  $i$ ,  $\beta$  is the vector of parameters to be estimated, and  $\epsilon_i$  is an error term assumed to be independently and identically distributed with zero mean and constant variance.

From this specification, the probability of mobile money account ownership can be expressed as:

$$p_i = P(Y_i = 1) = F(x_i\beta) ,$$

where  $F(\cdot)$  denotes the cumulative distribution function of the error term. In the logit model,  $F(\cdot)$  follows the logistic distribution:

$$F(x) = \frac{1}{1 + \exp^{-x}}$$

- **Model estimation**

The parameters of the model are estimated using the maximum likelihood method. Under the assumption of independence across individual observations, the likelihood function for a sample of size N can be written as:

$$L(y_i, \beta) = \prod_{i=1}^N p_i^{y_i} (1 - p_i)^{1-y_i}$$

where  $p_i = F(x_i\beta)$ ,

Numerical optimization methods are then used to maximize the likelihood function with respect to the parameter vector  $\beta$ . The estimated parameters are obtained as:

$$\hat{\beta} = \arg \max \log(L(y, \beta))$$

where  $\log(\cdot)$  denotes the logarithm of the likelihood function.

- **Explanatory variables**

In addition to socio-demographic characteristics and access to electricity and mobile internet, the model also includes bank account ownership as an explanatory variable. This approach is inspired by the studies of Khera et al. (2021) and Fall and Birba (2019). Including this variable in the model makes it possible to explore whether mobile financial inclusion and bank account ownership are complementary or substitutable. A positive coefficient would indicate complementarity, whereas a negative coefficient would suggest substitution between the two types of financial services. If the coefficient is not statistically significant, this would indicate independence between the two forms of account ownership.

The model also controls for individuals' membership in microfinance institutions in order to examine whether affiliation with microfinance institutions influences the adoption of mobile money services.

Table 1 : Variables included in the model

Variable	Categories	Reference category
Gender	Male ; Female	Male
Age	Youth (15–24 years) ; Adult (25 years and above)	Adult
Education level	None ; Primary ; Secondary ; Tertiary	None
Employment status	Employed ; Not employed	Not employed
Poverty status	Poor ; Non-poor	Non-poor
Phone ownership	Yes ; No	No
Access to electricity (elec_ac)	Yes ; No	No
Internet access	Yes ; No	No
Area of residence	Urban ; Rural	Urban
Bank account ownership (bank)	Yes ; No	No
Microfinance account ownership (sfd)	Yes ; No	No

Source: Authors' calculations based on EHCVM 2021/2022.

## 4.2. Alternative specifications

To assess the robustness of the baseline results, three alternative specifications are estimated using cluster-level panel data constructed from the two rounds of the EHCVM survey.

### Cluster panel construction

The EHCVM survey was conducted in two rounds (2018/2019 and 2021/2022) using a two-stage sampling design. First, enumeration areas (clusters) were selected with probability proportional to size. Second, twelve households were systematically selected within each cluster, and all individuals in these households were surveyed. The second round revisited the same households as the first; when a household could not be located, it was replaced within the same cluster. As a result, the set of clusters remains identical across the two waves, allowing the construction of a cluster-level panel with  $T=2$ .

For this panel, the unit of observation is cluster  $g$  at period  $t$ . The dependent variable is the proportion of individuals holding a mobile money account in cluster  $g$  at time  $t$  ( $y_{gt} \in [0,1]$ ). Explanatory variables are aggregated at the cluster level as proportions or averages (e.g., proportion of women, proportion of individuals with access to electricity).

#### ❖ Fractional logit model

The fractional logit model (Papke & Wooldridge, 1996) is used to model the conditional mean of the dependent variable bounded in the interval  $[0,1]$ . This specification allows observations at the boundaries without requiring transformations. The model estimates :

$$E(y_{gt} | X_{gt}) = F(X_{gt}\beta)$$

where  $F(\cdot)$  is the logistic cumulative distribution function. Parameters are estimated by quasi-maximum likelihood with robust sandwich standard errors. This specification respects the bounded nature of the dependent variable and therefore provides a suitable robustness check.

#### ❖ Generalized Estimating Equations (GEE)

Generalized Estimating Equations (Liang & Zeger, 1986) are used to estimate population-average effects while accounting for intra-cluster correlation across survey waves. When the cluster sample size  $m_{gt}$  is known, the dependent variable is treated as binomial,  $y_{gt} \sim \text{Binomial}(m_{gt}, \pi_{gt})$ . GEE models explicitly account for cluster-level correlation and provide estimates of average effects at the population level.

GEE models explicitly account for cluster-level correlation and provide estimates of average effects at the population level.

#### ❖ Correlated random effects (Mundlak approach)

In short panels ( $T=2$ ), nonlinear fixed-effects models are generally unsuitable due to the incidental parameters problem. The correlated random effects approach proposed by Mundlak (1978) addresses the potential correlation between unobserved cluster heterogeneity and explanatory variables by augmenting the model with cluster-level time averages of the regressors. This approach helps distinguish between within-cluster and between-cluster effects while correcting for potential omitted variable bias arising from correlated unobserved heterogeneity.

### 4.3. Identification strategy and robustness assessment

The same set of aggregated explanatory variables is used across the three specifications (fractional logit, binomial-logit GEE, and Mundlak-CRE fractional logit). Robustness is assessed based on :

- (i) the stability of coefficient signs and marginal effects,
- (ii) statistical significance at conventional levels, and
- (iii) consistency across models for key variables such as connectivity, digital equipment, education, employment, and access to electricity.

Detailed results are reported in the appendix through summary tables presenting coefficient signs and significance levels. The main text focuses on the main converging findings and discusses remaining differences across specifications.

## 5. Empirical Results

This section presents and discusses the empirical findings of the study.

### 5.1. Baseline results and Discussion of findings

The table below reports the results of the baseline model.

Table 2 : Baseline results

VARIABLES	BEN	BFA	CIV	GNB	MLI	NER	SEN	TGO
bank	0.021	0.090***	-0.023	0.018**	-0.007	0.002	0.046**	0.007
	(0.016)	(0.019)	(0.019)	(0.009)	(0.016)	(0.002)	(0.021)	(0.019)
sfd	0.005	0.027*	-0.083***	-0.042*	0.100***	0.005	-0.022	0.062***
	(0.017)	(0.015)	(0.030)	(0.022)	(0.030)	(0.005)	(0.026)	(0.012)
internet	0.051***	0.054***	0.105***	0.071***	0.057***	0.002**	0.154***	0.104***
	(0.010)	(0.013)	(0.012)	(0.009)	(0.012)	(0.001)	(0.010)	(0.014)
phone	0.240***	0.171***	0.355***	0.063***	0.176***	0.001***	0.372***	0.333***
	(0.010)	(0.010)	(0.012)	(0.006)	(0.010)	(0.000)	(0.012)	(0.013)
elec_ac	0.040***	-0.021	0.047***	0.015	0.027	0.002**	0.028**	0.015
	(0.012)	(0.019)	(0.014)	(0.013)	(0.023)	(0.001)	(0.013)	(0.019)
poor	-0.028**	0.012	-0.055***	-0.007	-0.024**	0.001	-0.049***	-0.030**
	(0.011)	(0.014)	(0.010)	(0.009)	(0.012)	(0.002)	(0.010)	(0.014)
primary	0.038***	0.016	0.074***	-0.015*	0.013	0.001	0.072***	0.039***

	(0.010)	(0.011)	(0.010)	(0.009)	(0.013)	(0.002)	(0.009)	(0.013)
secondary	0.052***	0.050***	0.111***	0.018	0.044***	0.002	0.081***	0.076***
	(0.010)	(0.013)	(0.011)	(0.012)	(0.012)	(0.001)	(0.009)	(0.014)
employed	0.049***	0.032***	0.099***	0.021***	0.042***	0.001**	0.068***	0.040***
	(0.009)	(0.009)	(0.009)	(0.006)	(0.009)	(0.000)	(0.007)	(0.012)
rural	-0.038**	-0.074***	-0.083***	-0.034**	-0.008	-0.000	-0.019	-0.060**
	(0.017)	(0.023)	(0.016)	(0.015)	(0.025)	(0.001)	(0.012)	(0.026)
female	-0.017***	-0.058***	-0.072***	-0.023***	-0.055***	-0.001**	-0.051***	-0.022***
	(0.006)	(0.007)	(0.008)	(0.005)	(0.008)	(0.000)	(0.006)	(0.008)
youth	-0.019**	-0.047***	-0.110***	-0.012*	-0.058***	-0.001	-0.105***	-0.042***
	(0.009)	(0.009)	(0.011)	(0.007)	(0.008)	(0.001)	(0.009)	(0.013)
<i>Number of observations</i>	22.339	23.877	33.994	24,128	22.648	16.273	34.464	15.469

Source: Authors' calculations based on EHCVM 2021/2022.

#### ❖ Digital access

Access to digital technologies emerges as a key determinant of mobile money adoption. Phone ownership (phone) and internet access (internet) display positive and statistically significant marginal effects across all countries. This stability across national contexts suggests that access to digital devices and connectivity constitutes a fundamental prerequisite for the use of mobile money services. In other words, adoption primarily depends on effective technological access rather than country-specific institutional conditions. These findings are consistent with previous studies emphasizing the role of mobile network coverage and internet connectivity in expanding digital financial services (Aker & Mbiti, 2010; Zins & Weill, 2016; Asongu & Nwachukwu, 2016).

#### ❖ Access to electricity

Access to electricity (elec\_ac) is positively associated with mobile money adoption in several countries, particularly Benin, Côte d'Ivoire, and Senegal. This result highlights the complementary role of electricity infrastructure in supporting digital financial services. Reliable electricity facilitates device charging, supports connectivity, and enhances the reliability of digital transactions. These results align with the literature documenting a positive relationship between electrification and the adoption of digital financial services (Houngbonon et al., 2021; Zins & Weill, 2016).

#### ❖ Employment status

Employment status is positively associated with mobile money adoption in all countries. Individuals who are employed are more likely to adopt mobile money due to more regular income flows and greater transaction needs, including peer-to-peer (P2P) transfers and merchant payments (P2B). According to the BCEAO (2023), these transactions represent a substantial share of the total value of digital

financial services in WAEMU. These findings are consistent with previous studies linking financial service usage to income stability and economic activity (Demirgüç-Kunt & Klapper, 2012; Pazarbasioglu et al., 2020).

#### ❖ Education

Education levels are generally positively associated with mobile money adoption, with stronger effects observed for secondary education. Higher levels of education likely facilitate the understanding and use of digital financial tools, such as USSD interfaces or mobile applications, as well as the management of personal identification numbers (PINs). These findings confirm the importance of human capital in promoting digital financial inclusion (Zins & Weill, 2016; Nokulunga et al., 2023).

#### ❖ Relationship with traditional financial institutions

The inclusion of variables related to traditional financial institutions allows us to examine the relationship between mobile money and conventional financial services. The results show that bank account ownership has a positive and statistically significant effect on mobile money adoption in several countries, including Burkina Faso, Senegal, and Guinea-Bissau. In other countries, the effect remains statistically insignificant.

Where the effect is positive, the results suggest complementarity between bank accounts and mobile money services. Individuals already integrated into the formal financial system may adopt mobile money as an additional transaction tool. These findings support the view that mobile money complements rather than substitutes traditional banking services in certain contexts.

#### ❖ Vulnerable groups

Finally, the results indicate that the probability of adopting mobile money is lower among poor individuals, women, young people, and residents of rural areas, although the magnitude of these effects varies across countries. These patterns highlight the persistence of socio-economic disparities in access to digital financial services. Addressing these gaps may require targeted policies such as financial literacy programs, expansion of rural agent networks, and pricing structures adapted to small-value transactions. These results are consistent with the disparities documented in the literature (Demirgüç-Kunt & Klapper, 2013; Zins & Weill, 2016).

## 5.2. Robustness results

To assess the robustness of the baseline results, we rely on two complementary indicators: (i) sign concordance, defined as the share of models that exhibit the majority sign for a given variable in each country; and (ii) the share of statistically significant estimates (at least  $p < 10\%$ ).

Based on these indicators, the robustness of each variable, for a given country, is classified into three levels:

- **Strong:** sign concordance  $\geq 0.75$  and statistical significance in most specifications;
- **Moderate:** only one of the two conditions is satisfied;
- **Weak:** none of the two conditions is satisfied.

Table 3 : Robustness summary of key variables (country averages)

Variable	Sign concordance (avg.)	Share of significant models (avg.)	Interpretation
internet	0.96	0.71	Robust positive effect
phone	0.93	0.82	Robust positive effect
bank	0.93	0.50	Positive effect, heterogeneous precision
sfd	0.93	0.36	Generally positive, weak significance
elec_ac	0.89	0.39	Positive effect, moderate significance
primary	0.86	0.61	Positive effect, often significant
rural	0.96	0.32	Negative effect, moderate significance
female	0.75	0.39	Heterogeneous effect across countries
youth	0.68	0.36	Fragile result (limited robustness)
poor	0.75	0.25	Mixed result (often insignificant)
employed	0.86	0.43	Mostly positive, heterogeneous

Source: Authors' calculations based on EHCVM 2021/2022.

1. **Internet access** : The effects are positive and highly stable across specifications. The average sign concordance reaches 0.96, while the share of significant models is 0.71. Both the Logit and GEE estimations yield robust coefficients, and the QMLE/Mundlak specifications confirm the expected direction in most cases. Although some country-specific variations exist, they do not alter the overall conclusion that internet access is a key determinant of mobile money adoption.
2. **Phone ownership (phone)** : The results are also positive and robust, with an average sign concordance of 0.93 and a significance rate of 0.82. The four estimation approaches converge in their conclusions, with strong statistical significance particularly in the Logit and GEE models. The QMLE and Mundlak specifications confirm the expected positive relationship.
3. **Bank account ownership (bank)** : The estimated coefficients are generally positive, although their statistical significance varies across countries and specifications (sign concordance: 0.93, share significant: 0.50). These findings suggest a complementarity between formal banking services and mobile money adoption, although the precision of the estimates remains heterogeneous.

4. **Microfinance institutions (sfd)** : The sign is frequently positive (sign concordance: **0.93**), but the relatively low share of significant models (**0.36**) suggests caution in interpretation. The effect may depend on local institutional configurations, such as the density of service points or the degree of integration with electronic money issuers.
5. **Control variables** : The control variables produce results broadly consistent with theoretical expectations. Access to electricity (elec\_ac) and education levels (primary and secondary education) generally increase the likelihood of adopting mobile money, although statistical significance varies across countries. Conversely, rural residence is typically associated with a lower probability of adoption (sign concordance  $\approx 0.96$ , moderate significance).

The effects associated with gender, youth status, poverty, and employment status appear more heterogeneous across countries and model specifications, with lower average significance levels, though they do not contradict the general patterns identified above.

## 6. Policy Implications

These findings provide an empirical basis for prioritizing key public policy levers. The largest gains are likely to come from investments aimed at improving the coverage and quality of mobile Internet infrastructure and enhancing the affordability of digital devices. These efforts should be complemented by policies promoting electrification and strengthening both digital and financial literacy. Expanding service points in rural areas, improving the interoperability of payment infrastructures, and reinforcing consumer protection frameworks represent additional policy avenues to address adoption constraints. Furthermore, stronger coordination between banks, microfinance institutions, and electronic money issuers appears crucial for transforming access into sustained and effective use of digital financial services.

## 7. Conclusion

This article examined the factors associated with mobile money adoption across WAEMU countries using a comparative econometric framework based on four estimators. The robustness assessment relied on both the consistency of coefficient signs across models and the frequency of statistical significance, complemented by graphical checks. This strategy made it possible to assess the directional stability of the effects and the associated statistical precision, country by country and variable by variable.

The results highlight the central role of technological access constraints. Internet access and mobile phone ownership display positive and highly stable effects across the Union. On average, sign concordance remains high for Internet ( $\approx 0.96$ ) and for phone ownership ( $\approx 0.93$ ), with shares of significant models close to 0.71 and 0.82 respectively. This regularity, also observed across the alternative specifications, confirms that connectivity and device ownership constitute key operational preconditions for adoption.

Institutional complementarities appear plausible, although with varying intensity. Holding a bank account is generally positively associated with mobile money adoption, although its statistical significance varies across countries and model specifications. Similarly, microfinance institutions (MFIs) most often display a positive association.

Infrastructure conditions and human capital also show the expected effects, with electrification and education levels generally facilitating adoption. Conversely, rural residence is associated with a lower probability of adopting mobile money, although with less systematic significance, reflecting access constraints such as network coverage, fixed costs of service deployment, and differences in service density. Socio-demographic characteristics, including gender, youth status, poverty, and employment status, appear more heterogeneous

and less frequently significant, suggesting that policy interventions should be targeted and context-specific rather than uniform across countries.

Finally, several limitations should be acknowledged. In particular, the analysis identifies associations rather than causal effects, as the available data do not allow the implementation of a credible identification strategy such as instrumental variables. Future research could explore causal mechanisms using panel data or natural experiments.

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Appendix

Table A.1 — Sign-and-stars matrices by country and model

<b>bank</b>	<b>Logit</b>	<b>QMLE</b>	<b>GEE</b>	<b>Mundlak</b>
Benin	'=+	'=+***	'=+**	'=+***
Burkina	'=+**	'=+***	'=+***	'=+***
Côte d'Ivoire	-	'=+***	'=+***	'=+***
Guinée-Bissau	'=+**	'=+	'=+	'=+*
Mali	-	-	-	'=+**
Niger	'=+	'=+	'=+	'=+
Senegal	'=+**	'=+***	'=+***	'=+***
Togo	'=+	'=+	'=+	'=+**

<b>sfd</b>	<b>Logit</b>	<b>QMLE</b>	<b>GEE</b>	<b>Mundlak</b>
Benin	=+	=+	=+	=+
Burkina	=+	=+	=+	=+
Côte d'Ivoire	_***	=+	=+	=+
Guinée-Bissau	_*	_***	_***	-
Mali	=+***	=+	=+	=+***
Niger	=+	=+	-	=+
Sénégal	-	-	-	-
Togo	=+***	=+***	=+***	=+***

<b>phone</b>	<b>Logit</b>	<b>QMLE</b>	<b>GEE</b>	<b>Mundlak</b>
Benin	=+***	=+***	=+***	=+***
Burkina	=+***	=+***	=+***	=+***
Côte d'Ivoire	=+***	=+***	=+***	=+***
Guinée-Bissau	=+***	=+	=+	_**
Mali	=+***	=+***	=+***	=+**
Niger	=+***	=+	=+	-
Sénégal	=+***	=+***	=+***	=+***
Togo	=+***	=+***	=+***	=+***

<b>Internet</b>	<b>Logit</b>	<b>QMLE</b>	<b>GEE</b>	<b>Mundlak</b>
Bénin	=+***	=+	=+***	=+
Burkina	=+***	=+***	=+***	=+***
Côte d'Ivoire	=+***	=+***	=+***	=+
Guinée-Bissau	=+***	=+***	=+***	=+***
Mali	=+***	=+***	=+***	=+***
Niger	=+**	=+	=+	=+
Sénégal	=+***	=+***	=+***	-
Togo	=+***	=+***	=+***	=+

<b>Elec_ac</b>	<b>Logit</b>	<b>QMLE</b>	<b>GEE</b>	<b>Mundlak</b>
Benin	=+***	=+***	=+	._**
Burkina	=+*	=+*	=+*	=+*
Côte d'Ivoire	=+***	=+***	=+***	=+***
Guinée-Bissau	=+	=+	=+	-
Mali	=+	=+	=+	=+
Niger	=+**	=+	=+	=+
Sénégal	=+**	=+	=+	=+***
Togo	=+	=+	=+	._***

<b>rural</b>	<b>Logit</b>	<b>QMLE</b>	<b>GEE</b>	<b>Mundlak</b>
Benin	._**	._***	-	-
Burkina	._***	._***	._***	._***
Côte d'Ivoire	._***	._***	._***	._***
Guinée-Bissau	._**	-	-	-
Mali	-	=+	=+	=+
Niger	-	-	-	-
Sénégal	-	-	-	._*
Togo	._**	-	-	-

<b>poor</b>	<b>Logit</b>	<b>QMLE</b>	<b>GEE</b>	<b>Mundlak</b>
Bénin	._**	=+	._***	-
Côte d'Ivoire	._***	-	-	=+
Guinée-Bissau	-	=+	=+	-
Mali	._**	-	-	-
Niger	=+	=+	=+	-
Sénégal	._***	-	-	._**
Togo	._**	=+	=+	-

<b>primary</b>	<b>Logit</b>	<b>QMLE</b>	<b>GEE</b>	<b>Mundlak</b>
Bénin	=+***	=+	=+***	=+***
poor	-	-	-	._*
Côte d'Ivoire	=+***	=+***	=+***	=+
Guinée-Bissau	._*	=+***	=+***	=+***
Mali	=+	=+***	=+***	=+
Niger	=+	-	-	-
Sénégal	=+***	=+***	=+***	=+***
Togo	=+***	-	-	=+

<b>female</b>	<b>Logit</b>	<b>QMLE</b>	<b>GEE</b>	<b>Mundlak</b>
Bénin	._***	=+	._**	-
Burkina	=+**	=+**	=+**	=+**
Côte d'Ivoire	._***	._*	-	=+
Guinée-Bissau	._***	=+	=+	=+
Mali	._***	=+	=+	=+
Niger	._**	=+	=+	=+**
Sénégal	._***	=+	=+	=+
Togo	._***	-	-	=+*

<b>youth</b>	<b>Logit</b>	<b>QMLE</b>	<b>GEE</b>	<b>Mundlak</b>
Bénin	._**	-	._***	._*
Burkina	._***	-	-	-
Côte d'Ivoire	._***	=+	=+	-
Guinée-Bissau	._*	._**	._**	=+
Mali	._***	=+	=+	-
Niger	-	=+	=+	=+
Sénégal	._***	-	-	=+
Togo	._***	=+	=+	-