

Macro-economic determinants of financial inclusion: evidence from West African Economic and Monetary Union (WAEMU)

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Abstract. *The aim of this paper is to identify the main macroeconomic determinants of financial inclusion in the WAEMU over the period 2007-2020. Our estimation results from GLS and RE reveal that income per capita, education, mobile phone access and gross fixed capital formation positively and significantly affect financial inclusion in WAEMU. However, our results show that final household consumption expenditure and the share of the population living in rural areas have a negative and significant impact on financial inclusion in WAEMU. This suggests the need to strengthen the financial education of populations, as well as investment in adequate infrastructure in rural areas, likely to attract investors from the financial system.*

Keywords: financial inclusion, panel data, GLS, WAEMU.

JEL Classification: C23, C59, G21, G23.

Introduction

The issue of financial inclusion has occupied a prominent place in the design and implementation of development policies since the late 1990s. For this reason, the Central Bank of West African States (CBWAS), along as most international institutions, considers universal access to finance as one of the pillars of empowerment for vulnerable groups. Theoretically, underdevelopment is linked to the inability to mobilize resources, which is characteristic of an inadequate or non-existing financial system (Bagehot, 1873). Schumpeter (1911) argued that financial services, and bank loans in particular, were indispensable to economic growth insofar as they improved productivity by encouraging technological innovation.

In literature, recent efforts have been made to theorize financial inclusion. Indeed, given that no theory of financial inclusion has been developed in the policy or academic literature, despite the growing interest of researchers in the issue, Ozili (2020) proposes a categorization of ideas and perspectives on financial inclusion into three groups of theories. These include theories of beneficiaries, providers and financing theories of financial inclusion. Later, Ozili (2023) develops an institutional theory of financial inclusion that should strengthen the capacity of financial inclusion theories to deal with often more complex external phenomena.

With regard to its effects on beneficiaries and hence on the economy as a whole, research shows that financial inclusion promotes economic growth (Demirguc-Kunt and Levine, 2009; Demirgüç-Kunt et al., 2007; Levine, 2005; Levine, 1997). It also reduces inequality and poverty, while raising the living standards of the poor (Beck et al. 2007; Kempson, 2006). Therefore, well-organised financial systems would have positive effects on economic growth, particularly in the long term.

There are arguments in the literature about the factors that may condition access and use of financial services. For Tuesta et al. (2015), a large number of non-financial factors such as telecommunications development, individual characteristics, cultural issues and policy implementation, among others, condition the use and quality of financial services. Financial inclusion can also be seen as a function of both structural and policy factors (Naceur et al., 2015; Evans and Adeoye, 2016). According to these authors, structural characteristics are related to population size and density, income per capita and the degree of informality in the economy. Policy factors, especially the degree of macroeconomic stability and the institutional framework, affect the costs and financial services delivered.

In WAEMU (West African Economic and Monetary Union), despite the measures taken by some governments to promote financial inclusion, efforts still need to be made. According to BCEAO (2021), in 2019, less than 20% of the adult population had access to basic banking services. In fact, the binarization rate in the narrow sense for the adult population has gone from 9.69% in 2009 to 18.027% in 2019. This low rate of access to banking services in the narrow sense is observed in all countries of the Union. The broader binarization rate, including local financial systems, has gone from 22.94% to 41.05%. This indicates that more than half the WAEMU population is still excluded from the financial system. The overall rate of use of financial services by the adult population remains below

expectations, although it has improved significantly in recent years due to mobile money services. This indicator has risen from 19.66% in 2009 to 71.66% in 2019 (BCEAO, 2021). This finding highlights the issue of the main determinants of financial inclusion in WAEMU. In other words, what are the main determinants of financial inclusion in WAEMU?

In recent economic literature, the analysis of the determinants of financial inclusion has been the subject of several empirical studies. Indeed, in a macroeconomic approach, most studies (Evans and Adeoye, 2016; Oyelami et al., 2017) agree that income per capita, the literacy rate and banking innovation have a significant and positive impact on financial inclusion. Furthermore, most studies based on a microeconomic approach emphasize the role of individual characteristics in explaining people's access to the formal financial system. They also conclude that the level of literacy, wealth and distance from financial service points significantly determine financial inclusion (Akudugu, 2013; Yakubu et al., 2017).

In WAEMU, some studies have focused on the issue of financial inclusion (Lanie, 2017 and Senou et al., 2019). Indeed, Lanie (2017) focusing on the determinants of demand and self-reported barriers to financial inclusion in WAEMU found that age, gender, employment status, education level and income are fundamental determinants of financial inclusion in WAEMU. Senou et al (2019) investigated the role of digital technologies on the dynamics of financial inclusion. Their results showed that the use of mobile phones and internet together is essential for financial inclusion in WAEMU countries. However, the literature has rarely examined the determinants of financial inclusion in its various dimensions (access, use and affordability of financial services).

This research fills this gap by examining the determinants of both the synthetic financial inclusion index and the dimensions and indicators of financial inclusion. We hypothesize that each dimension and indicator of financial inclusion has its own determinants, which are not necessarily those of the synthetic index of financial inclusion.

This paper provides two key contributions to the literature on the macroeconomic determinants of financial inclusion. Firstly, to our knowledge, it is the first study to examine both the determinants of financial inclusion as a whole, and those of its dimensions and indicators. Secondly, we construct the dimensions and the synthetic index of financial inclusion using the approach of Wang and Guan (2017) and then proceed with a regression analysis using generalized least squares (GLS) and random effects (RE). This provides insight into the main determinants of financial inclusion in the UEMOA.

The rest of the paper is structured as follows: Section 2 provides a brief literature review the determinants of financial inclusion. Section 3 outlines the methodology and data used in the analysis. Section 4 presents and discusses the main results, including robustness tests. Finally, Section 5 concludes.

1. Literature review

The purpose of this section is to highlight the theoretical and empirical work that has already been done on the determinants of financial inclusion. In this section, we first draw a distinction between financial inclusion and financial development. Secondly, we look at

the various theoretical arguments developed around the factors likely to influence access to and use of formal financial services by economic agents. Finally, we focus on empirical work related to the determinants of financial inclusion.

1.1. Conceptual aspects

This section aims to highlight the theoretical and empirical work already carried out on the determinants of financial inclusion. Firstly, we make a distinction between financial inclusion and financial development. Next, we look at the theoretical underpinnings of financial inclusion.

1.1.1. Financial inclusion and financial development: what distinction should be made?

Over time, researchers have focused much more on the role of a deep financial system (financial development) in the process of economic growth. But today, both researchers and public authorities are paying particular attention to financial inclusion. This shift towards financial inclusion rather than financial development could be explained by the fact that, according to Cull et al (2012), deep financial sectors are not necessarily accessible to everyone when financial services are almost entirely the preserve of the rich. So, what distinction can we make between financial inclusion and financial development? Researchers have been able to shed some light on this question. Some have looked at the definition of the two concepts, while others have tackled the meaning of the relationship between financial inclusion and financial development.

1.1.1.1. Distinction in view of definition

The concept of financial development has evolved considerably over time. Shaw (1973) defined it as “*the accumulation of financial assets at a faster rate than the accumulation of non-financial assets*”. For Levine (2005) “*financial development occurs when financial instruments, markets, and intermediaries reduce, but do not necessarily eliminate, the costs of obtaining information, the costs of executing contracts, and the costs of transactions, and therefore do a better job of providing five financial functions*”. The five financial functions whose improvement implies financial development, according to Levine (2005) are: (i) *producing ex-ante information on projects and promoting the optimal allocation of resources*, (ii) *monitoring investments and controlling companies*, (iii) *facilitating financial transactions, hedging against risks, diversifying assets and pooling risks*, (iv) *ensuring the mobilization of savings* and (v) *facilitating the exchange of goods and services*.

Hlophe (2018) defines financial development as improving the size, efficiency and stability of the financial system. For the same author, financial inclusion means that individuals and businesses have access to affordable financial products to meet their needs.

1.1.1.2. Link between financial inclusion and financial development

Researchers have generally supported the argument that financial inclusion is a component of financial development (Lenka, 2021; Hlophe, 2018; Rasheed et al., 2016). Indeed, Lenka (2021) argues that financial inclusion is an integral dimension of financial development, as well as economic growth. Consequently, affordable and transparent financial products and services are useful for the development of the financial sector.

Based on the premise that developing countries can be financially developed for many reasons, but not always financially inclusive due to high income inequality, Ozili (2020) and Rasheed et al. (2016) argue that financial inclusion is a fundamental determinant of financial sector development. Thus, according to Rasheed et al (2016), increasing financial inclusion could lead to financial development and hence economic development. For Sarma (2008), policymakers are trying to establish inclusive financial systems in developing countries because financial development is sustained in the long-term when all people have better financial access.

1.1.2. Theoretical foundations of financial inclusion

In the literature, financial inclusion has only recently been theorized. Indeed, based on the observation that no theory of financial inclusion has been developed in the policy or academic literature, Ozili (2020) proposes a categorization of theories of financial inclusion into three groups, namely: financial inclusion beneficiaries, theories of providers (FS suppliers) of financial inclusion and financing of financial inclusion. Next, Ozili (2023) develops a new theory called the institutional theory of financial inclusion with a view to ensuring the capacity of financial inclusion theories to deal with more complex external phenomena.

1.1.2.1. Theories of the beneficiaries of financial inclusion

In the literature, the question of the beneficiaries of financial inclusion has given rise to contradictory ideas among researchers. Indeed, some studies argue that the poor are the ultimate beneficiaries of financial inclusion (Bhandari, 2018), others believe that women are the beneficiaries of the effects of financial inclusion (Ghosh and Vinod, 2017; Demirguc-Kunt et al., 2013b; Swamy, 2014) while some believe that the economy and the financial system are the beneficiaries of financial inclusion (Mehrotra and Yetman, 2015; Kim et al., 2018; Swamy, 2014; Ozili, 2018). For Ozili (2020), young people, the elderly, institutionalized people, people with disabilities and individuals excluded from the financial system due to criminal offences are also potential beneficiaries of financial inclusion. These different approaches to the beneficiaries of financial inclusion have led Ozili (2020) to formulate four theories to better explain who benefits from financial inclusion. The first considers formal financial services as public goods that must be provided to everyone for the benefit of all. The dissatisfaction theory of financial inclusion defends the idea that a country's FI programs should first target all those individuals who previously existed in the formal financial sector but left it because they were dissatisfied with the rules of engagement in the formal financial sector. Whereas, the FI theory of vulnerable groups argues that the focus of a country's financial inclusion programs should be on the vulnerable members of society (such as the poor, the young, women and the elderly) who suffer most from economic hardship and crisis. Thus, to achieve financial inclusion for these groups, Ozili (2020) advocates that the government make social transfers to the formal account of these vulnerable people. Finally, the systemic theory of financial inclusion states that the effects of financial inclusion are achieved through the existing sub-systems (such as economic, social and financial systems) on which financial inclusion relies. Therefore, greater financial inclusion will have positive effects on the sub-systems on which it is based.

1.1.2.2. Financial inclusion providers' theories

As far as the providers of FS are concerned, several arguments have also been put forward on this issue. Some believe that the government should provide formal financial services to the population (Aggarwal and Klapper, 2013; Staschen and Nelson, 2013; Chibba, 2009). Others believe that private companies, such as banks and financial technology companies, can provide formal financial services to the population more efficiently (Gabor and Brooks, 2017; Ozili, 2018). Other ideas suggest that formal financial services can be delivered through cooperation between the public and private sectors (Arun and Kamath, 2015; Pearce, 2011). These expectations about the provision, or supply, of formal financial services require an underlying thought process to establish why these agents are needed in the first place to provide formal financial services. In this regard, Ozili (2020) puts forward five (05) theories or perspectives relating to the provision of FS.

The community-level theory of financial inclusion states that formal financial services should be provided to the excluded population through their community leaders. According to this theory, community leaders are influential within their communities and can use their influence to encourage or persuade community members to join the formal financial sector. The public service theory of financial inclusion argues that financial inclusion is a public responsibility that government owes to its citizens. The government, through its public institutions, has a duty to provide formal financial services to all citizens. This theory responds to Mankiw's (1986) assertion. In fact, Mankiw (1986) believes that financial markets can't operate freely and that state intervention is essential, especially to assume the function of lender of last resort.

Financial inclusion special agent theory defends the idea that formal financial services should be provided to the excluded population by special agents. The rationale for this theory is that the provision of formal financial services to unbanked adults can be difficult due to the nature of remote communities, their population or geography. Thus, the special agent must: (i) be a highly skilled and specialized agent, (ii) understand the particularities of the excluded population, (iii) understand the existing informal financial system in the communities where the excluded members of the population reside, (iv) identify areas for improvement through innovation, and (v) devise a means of integrating the excluded communities into the formal financial system.

Furthermore, the collaborative intervention theory of financial inclusion states that formal financial services should be delivered to the excluded population through a collaborative multi-stakeholder intervention. This theory suggests that a joint effort by several stakeholders is necessary to bring the excluded population into the formal financial sector. Finally, the theory of financial inclusion based on financial literacy focuses on the financial education of citizens. It argues that financial education will increase people's willingness to participate in the formal financial sector.

1.1.2.3. Financing theories of financial inclusion

The issue of how to finance financial inclusion expenditure for the population is a major challenge. Some analysts believe that public money (taxpayers' money) should be used to fund financial inclusion programs (Marshall, 2004). Others believe that private sector

capitalists should fund financial inclusion programs because they have contributed to widening the income inequality gap between the poor and the rich (Mohiuddin, 2015). Other ideas suggest that financial inclusion programs should be jointly funded by the public and private sectors (Dashi et al., 2013; Cobb et al., 2016). Based on these ideas, Ozili (2020) formulates three theories likely to explain the process of financing financial inclusion.

The private money theory of financial inclusion states that financial inclusion initiatives should be privately funded. Ozili (2020) explains this theory by the fact that private funders would: (i) demand greater accountability from the users of their funds, (ii) ensure that private funds are used effectively, and (iii) ensure that formal financial services are provided to excluded members of the population. Whereas the public money theory of financial inclusion argues that financial inclusion programs should be funded by public money. According to defenders of this theory (Ozili, 2020; Dashi et al., 2013) financial inclusion programs should be funded by government budgets. The intervention fund theory of financial inclusion argues that financial inclusion activities and plans should be funded by special interventions from various donors rather than by taxpayers' money.

1.1.2.4. The institutional theory of financial inclusion

In the literature, several studies have emphasized the effect of institutional quality on the level of financial inclusion (Nkoa and Song, 2020; Ali et al., 2022; Aracil et al., 2022). Based on these results, Ozili (2023) develops an institutional theory of financial inclusion. The latter stipulates that people constantly interact with the formal and informal institutions of society, and their constant interactions with these institutions shape their opinion on whether and how to access formal financial services. People with incomplete information about how to access formal finance will be motivated to interact with trusted informal institutions to obtain more information that forms the basis of their decision-making. These opinions influence their decision to join or remain outside the formal financial sector, which affects the level of financial inclusion.

Well before Ozili (2023), Acemoglu et al (2003) argue that institutional endowments and the proper functioning of institutions can also be determinants of the success of financial policies. With regard to informal finance, Christensen (1993) considers that for informal finance to be viable, certain conditions must be met, in particular: *(i) low transaction, information and management costs; (ii) the existence of minimum reserves to ensure the financial transformation function and the necessary guarantees in the event of default.* According to Kapur (1992), the activities financed by informal loans are often illegal and lenders are not protected in the event of borrower bankruptcy. Thus, for him, informal finance is only used to finance small-scale micro-projects, while recourse to bank financing is indisputable for the financing of major investment and development projects.

1.2. Empirical literature review on financial inclusion determinants

A number of empirical studies have attempted to identify the determinants of financial inclusion. However, most of them have focused on approximating the financial inclusion index with an indicator that could only respond to a single dimension of financial inclusion. Two approaches (notably microeconomic and macroeconomic analysis) have been used in

the literature to identify the factors (supply, demand and institutional) likely to influence people's capacity to be included in the formal financial system.

1.2.1. Macroeconomic determinants of financial inclusion

Some researchers have taken a macroeconomic approach to identifying the determinants of financial inclusion. Through this approach, most of them have been able to point to individual characteristics and certain macroeconomic factors likely to influence the financial inclusion capacity of economic agents. With this in mind, Wokabi and Fatoki (2019) examine a sample of five (5) East African countries over the period 2000-2016. They find that rural population share and income level are the main determinants of financial inclusion in East Africa. At the same time, Gebrehiwot and Makina (2019) adopt the approach advocated by Sarma and Pais (2011) to calculate the financial inclusion index on a sample of 27 African countries over the period 2004-2013. The results of the GMM estimation reveal that the lagged value of the financial inclusion index, per capita income and telephone infrastructure positively and significantly affect the financial inclusion of people in Africa. However, public borrowing from financial institutions negatively and significantly affects the level of financial inclusion of the populations of these countries. Long before Gebrehiwot and Makina (2019), Evans and Adeoye (2016) found that per capita income, literacy rate, the presence of Islamic banks and their activities significantly and positively influence the financial inclusion of populations. They also revealed that the inflation rate and the interest rate on deposits do not influence the level of financial inclusion.

Looking at the specific case of 29 Indian cities over the period 2006-2014, Rajput (2017) finds that per capita domestic product, the proportion of factories and the employee base are significant variables indicating that income and employment lead the public to be more active, aware and interested in banking activities, which contributes to financial inclusion. Following Rajput (2017), Raichoudhury (2020) uses, a panel consisting of 27 Indian states over a period of four (04) years (2012-2015). He finds that income, infrastructure and employment opportunities are perhaps the most important determinants of financial inclusion.

Oyelami et al (2017) investigate the determinants of financial inclusion in sub-Saharan Africa; through a sample of 26 countries over the period 2004-2015. To do so, they use a staggered lag autoregressive model (ARDL) on panel data from the region. The results of the study reveal that financial inclusion in the region is significantly influenced by secondary demand factors, notably income level and literacy, and secondary supply factors such as interest rates and banking innovation through the use of ATMs.

Sarma and Pais (2008) focus on data available from 49 countries in 2004 (cross-sectional data) using the three fundamental dimensions of financial inclusion such as accessibility, availability and use of banking services. The Ordinary Least Squares (OLS) results reveal that per capita income, asphalted roads, mobile telephony and the internet have a positive and significant influence on people's financial inclusion. Foreign assets, on the other hand, have a negative and significant influence on financial inclusion.

1.2.2. Financial inclusion determinants: a microeconomic analysis

At the microeconomic level, some researchers have been able to highlight the characteristics likely to influence the capacity of economic agents to be included in the formal financial system. For example, Abdu and Adem (2021) examine the determinants of financial inclusion in the Afar region of Ethiopia. Their results from regressions of data collected from administrative structures using the logistic method reveal that age, financial education and mobile banking services positively affect financial inclusion. In addition, the results reveal that barriers to financial inclusion, notably difficulties accessing credit, interest rates, lack of financial education, lack of internet access, lack of collateral, lack of confidence in financial institutions and difficulties accessing commercial banks and ATMs, are all factors limiting financial inclusion in the Afar region.

Well before Abdu and Adem (2021), Mhlanga and Denhere (2020) attempted to identify the major pillars of financial inclusion in South Africa. To this end, they focus on data taken from the 2018 General Household Survey (GHS) database, composed of 20,000 individuals aged 15-88. Logit estimates show that age, education, income, race, gender and marital status are the main determinants of financial inclusion in South Africa. At the same time, Dar and Ahmed (2020) look at the determinants of and barriers to financial inclusion in India. To do so, they base their analysis on data from the World Bank's financial database (Global Findex, 2017). These data concern a sample of 3,000 people aged over 15. Estimates using the probit method show that gender, age, level of education and income have a significant impact on the different variables used as proxies for the level of financial inclusion in India. These variables also have a significant impact on savings and informal borrowing. Focusing on the Zimbabwean case, Abel et al (2018) find that age, level of education and financial literacy, income level and internet connectivity positively affect financial inclusion. However, documentation required to open a bank account and distance to a financial services access point were found to be negatively related to inclusion in the formal financial system in Zimbabwe.

Lanie (2017) examines the determinants of financial inclusion in the WAEMU, using data from the 2014 global survey. Firstly, the results of the maximum likelihood estimations indicate that individual characteristics including: age, gender, employment status, level of education and income determine financial inclusion in WAEMU. Secondly, the results of the estimation of the relationship between self-reported barriers and individual characteristics show that level of education and income are the main factors which affect financial inclusion in the WAEMU.

In order to identify the possibilities of access to postal services for different social categories of the population, Clotteau and Measho (2016) use survey data collected from 201 Posts worldwide through the Postal Union. The results show that 183 Posts (91%) confirm that, in the majority of cases, the Post accepts all types of customers, whether rich or poor, employed or unemployed, male or female. This fact shows that postal services do not generally discriminate against their customers. In the same way, Rao (2015), conducts a study carried out jointly with UN Women using data from Global Findex (2014). This study shows that, in developing countries, posts that offer account-based services have twice as many female customers as banks, while the financial inclusion rate of women

worldwide is still 7% lower than that of men. At the same time, Zulfiqar et al (2016) examine the relationship between financial inclusion and individual characteristics in Pakistan. Their results from estimating a probit model confirm that education level, income and gender discrimination are determinants of financial inclusion. This highlights that full and easy financial access to all segments of society could help promote and strengthen inclusive and sustainable economic growth for the benefit of all. Jabir (2017) investigates the determinants as well as the effect of financial inclusion on poverty reduction in sub-Saharan Africa. He uses a probit model to analyze data collected from 35 countries and nearly 35,000 individuals. The results show that higher levels of education and income have a positive influence on financial inclusion. They also show that age and age squared are linked positively and negatively respectively on the level of financial inclusion.

Peña et al (2014) examine the determinants of financial inclusion in Mexico, to establish a correspondence between the indicators credit and productive savings. To do this, they use the general linear regression model to analyze World Bank 2012 survey data. Their estimates lead them to conclude that individual characteristics, especially age, geographical location of the household, education and marital status, have a significant influence on the inclusion in the formal financial system of populations with a high level of education.

Clamara et al (2014) investigate the factors determining the likelihood of financial inclusion of households and businesses in PERU. They use a quantitative approach to determinants based on micro survey data. Significant correlation is used to identify the determinants of financial inclusion in PERU. Their results show that vulnerable groups (women and individuals living in rural areas) are more exposed to difficulties in accessing the formal financial system.

Beck et al (2007) try to measure financial inclusion and identify its determinants. They use survey data from 99 countries. These authors measure financial inclusion using the number of branches and ATMs in relation to the population and the geographical and demographic penetration ratio of the banking system. They find that a high number of bank branches and ATMs is interpreted as a broadening of the opportunities for people and businesses to access the banking system in these countries.

Akudugu (2013) examines the determinants of financial inclusion in West Africa with a particular focus on Ghana. In his analysis, this author uses data collected from 1,000 adults in Ghana and includes different wealth classes, occupations, geographical locations, gender and generations. Using the logit model, he estimates that: the age of individuals, literacy level, wealth level, distance from financial institutions, lack of documentation, lack of confidence in institutions, monetary poverty and social networks as reflected in family relationships are the significant determinants of financial inclusion in Ghana. Subsequently, Yakubu et al (2017) analyze the determinants of financial inclusion in Northern Ghana, using primary survey data. The results obtained, based on the estimation of a discriminant function model, show that the most significant determinants of financial inclusion in northern Ghana (in order of importance) are 'age', 'cost of financial services', 'capacity', 'literacy', 'distance' and 'employment'.

Soumaré et al (2016) analyze the determinants of financial inclusion in Central and West Africa. Their analysis using logit and probit methods of data from the World Bank database (Global Findex, 2011) on 18 countries (including 10 from ECOWAS and 8 from ECCAS, with a sample of 1,000 respondents per country) indicates that access to formal finance in both regions is mainly determined by individual characteristics such as gender, education, age, income, area of residence, employment status, marital status, household size and degree of trust in financial institutions. In addition, they find that education level and place of residence are important individual characteristics of access to a formal account in both regions and in Africa. However, being male and/or married are positive determinants of financial inclusion for Central Africa and the continent as a whole, while income is important in West Africa and Africa as a whole. In addition, household size has a negative impact on account ownership in West Africa and not in Central Africa.

Tuesta et al (2015) use a microeconomic perspective to analyze the three dimensions (access, use and barriers) that determine financial inclusion in Argentina. Analysis of data from the World Bank's Global Findex database in 2012 reveals that, in terms of supply, formal financial services are accessible through channels including bank branches and ATMs, with regulation for financial inclusion still in its infancy, unlike the situation in its neighbors. In terms of use, a person's level of education, income and age are all important variables that determine whether or not they hold financial products such as accounts, credit and debit cards, formal credit and electronic payments. Finally, the factors affecting the perception of the different barriers to involuntary exclusion are: income and age. At the same time, Kimutai (2015), looking at the Kenyan rural environment (Marakwet), based on the results of descriptive statistics and statistical inference, concludes that financial education, infrastructure, internet access and the quality of branches all play a role in explaining the problem of financial inclusion in Marakwet.

Using the World Bank Group's Global Findex 2014 database on 37 African countries, Zins and Weill (2016) set out to examine the determinants of financial inclusion in Africa. The probit analysis of these data reveals that individual characteristics are significantly linked to financial inclusion. In fact, being a woman considerably reduces the probability of having a formal account or formal savings, while no significant result is observed for formal credit. Age has a non-linear relationship with the three financial inclusion indicators, with a positive and significant coefficient for age and a negative and significant coefficient for age². Consequently, older people are more likely to be financially included, but after a certain age, the probability of being financially included decreases. In addition, higher income is associated with greater financial inclusion. The income dummy variables are all significantly negative for all three indicators of financial inclusion, with higher coefficients for the income quintile dummy variables indicating income. Education is positively associated with all indicators of financial inclusion. This leads them to conclude that education and income are the most important individual characteristics explaining inclusion in the formal financial system.

Based on a review of the empirical literature, we find that few studies to our knowledge, particularly at the macro level, have managed to capture both the determinants of financial inclusion as a whole and those of its various dimensions and indicators. This research aims

to fill this gap. It identifies the macroeconomic factors that can have a simultaneous impact on financial inclusion as a whole, as well as on its dimensions and indicators in the WAEMU area.

2. Methodology

This section focuses on the methodological approach applied in this study. It details the measurement of financial inclusion, presents the empirical model, and describes the nature and sources of the data.

2.1. Measuring financial inclusion: Process used to calculate the index of financial inclusion (IFI)

In the literature, certain studies (Beck et al., 2007; Sarma, 2008; Sarma and Pais, 2011; Camara and Tuesta, 2014; Wang and Guan, 2017) have attempted to demonstrate how to measure financial inclusion. However, the proposed methods for calculating financial inclusion indicators have faced criticism, highlighting their limitations.

Therefore, in our study, we follow the method proposed by Wang and Guan (2017). Our FII is constructed as a multidimensional index and incorporates information on the three main dimensions of financial services: access (Access), usage (Usage), and price accessibility (Price_Access). The methodology proposed by Wang and Guan (2017) not only estimates the weight of each indicator in forming the different dimensions of financial inclusion but also provides weighting for each dimension in the calculation of the overall index⁽¹⁾.

It should be noted that the BCEAO (Central Bank of West African States) uses principal component analysis (PCA) in its calculation of the synthetic financial inclusion index, drawing inspiration from the work of Camara and Tuesta (2014). Camara and Tuesta (2014), in fact, construct a multidimensional financial inclusion index composed of three dimensions through PCA. However, the PCA used by these authors only measures linear relationships between explanatory variables.

The construction of our financial inclusion index, in line with the approach proposed by Wang and Guan (2017), requires the prior transformation of each indicator using the following formula:

$$x_{ij} = \frac{A_{ij} - m_{ij}}{M_{ij} - m_{ij}} \quad (1)$$

where x_{ij} denotes the transformed value of indicator j in dimension i of the FII; A_{ij} is the current value of the indicator, and m_{ij} and M_{ij} are the minimum and maximum values of each indicator, respectively. After transformation, the value of each indicator falls between 0 and 1 ($0 \leq x_{ij} \leq 1$).

Each dimension i of the IFI, denoted ifi_i , is calculated using the following formula:

$$ifi_i = 1 - \frac{\sqrt{w_{i1}^2(1-x_{i1})^2 + w_{i2}^2(1-x_{i2})^2 + \dots + w_{in}^2(1-x_{in})^2}}{\sqrt{(w_{i1}^2 + w_{i2}^2 + \dots + w_{in}^2)}} \quad (2)$$

where w_{ij} represents the weight of indicator j ($j = 1, 2, \dots, n$) within dimension i ($i = 1, 2, 3$). In this article, unlike Sarma (2011), who assigned standard weights to different indicators and dimensions, we calculate the weight using an objective weighting method called the coefficient of variation (CV). The CV was originally used in probability theory and statistics to measure the dispersion of a probability distribution or frequency distribution. It is defined as the ratio of the standard deviation σ to the mean μ (Wang and Guan, 2017).

Thus, the weight of each indicator is defined as the proportion of its CV relative to the total sum of the CVs of all indicators. Accordingly, the weight of indicator j in dimension i is given by:

$$w_{ij} = \frac{V_{ij}}{\sum_j V_{ij}} \quad (3)$$

where V_{ij} is the CV of indicator j within dimension i . Then, the final Financial Inclusion Index (FII) is calculated using the following formula:

$$IFI = 1 - \frac{\sqrt{w_1^2(1-ifi_1)^2 + w_2^2(1-ifi_2)^2 + w_3^2(1-ifi_3)^2}}{\sqrt{(w_1^2 + w_2^2 + w_3^2)}} \quad (4)^{(2)}$$

2.2. Specification of the Empirical Model

In this study, we aim to analyze the determinants of financial inclusion within the WAEMU region. Based on theoretical and empirical literature (Raichoudhury, 2020; Dar and Ahmed, 2020; Wokabi and Fatoki, 2019; Sarma and Pais, 2011) presented above, which highlights various factors that may influence the inclusion of populations in the formal financial system, we deduce that financial inclusion can be modeled as follows:

$$fincl = f(\log GDP, Remittances, Consumption, Educ, public_spend, Phone, FBCF, Rural_pop) \quad (5)$$

With $fincl$: represents the vector of various dimensions and indicators (access and usage of financial services) of financial inclusion calculated following the approach recommended by Wang and Guan (2017); $\log GDP$: the logarithm of income per capita, with an expected positive sign. Higher income levels are associated with greater financial inclusion; $Remittances$: the share of remittances received as a percentage of GDP, expected to have a positive sign. Remittances increase household resources, potentially boosting their financial inclusion; $Consumption$: household final consumption expenditures as a percentage of GDP, with an expected negative sign. This choice is based on the idea that consumption is a key component of household income, and an increase in household consumption expenditures could limit their capacity to save, thus affecting their

ability to smooth consumption in the future; *Educ*: the gross primary enrollment rate, with an expected positive sign. This reflects the hypothesis that a more educated population is better equipped to understand the benefits of using financial products and services, indicating a positive relationship with financial inclusion; *Phone*: access to mobile phones, with an expected positive coefficient sign. This variable assesses the influence of recent innovations in mobile telephony, such as mobile banking, on the level of financial inclusion in the WAEMU region; *Pub_spend*: public expenditures as a percentage of GDP, with an expected positive sign. Public spending can enhance infrastructure and services that promote financial inclusion; *FBCF*: gross fixed capital formation, with an expected positive sign, as investments in capital formation can stimulate economic activity and support financial inclusion; *Rural_pop*: the share of the population living in rural areas, with an expected negative sign. The use of this variable aims to capture the effect of the distance of populations from urban centers on the level of financial inclusion. Generally, the points of sale for traditional financial services are concentrated in urban areas, which can limit access to financial services for rural populations. As a result, a higher proportion of the rural population is expected to correlate with lower levels of financial inclusion.

$$fincl = (IFI, Access, Use, Price_access, TGPSFd, TGPSFg, TGUSF, TBS, TBE) \quad (6)$$

With: IFI: the synthetic financial inclusion index; Access, Use, and Price access: denote the dimensions of access, usage, and price accessibility of financial services, respectively; TGPSFd: the total demographic penetration rate of financial services; TGPSFg: the total geographical penetration rate of financial services; TGUSF: the total global usage rate of financial services; TBS: the strict banking rate; TBE: the expanded banking rate.

Given the nature of our data and the size of our sample (number of individuals N is less than the number of years T), we use the generalized least squares (GLS) estimation technique in this study. For the results of the GLS to be valid, the number of years of study (T) must be at least as large as the sample size (number of countries N), as there must be at least as many observation periods as there are panels. In this study, we have a sample of eight countries and a study duration of thirteen (13) years covering the period from 2007 to 2020.

To this end, the general equation for identifying the main determinants of financial inclusion in the WAEMU can be expressed in the following general form:

$$Y_{it} = \beta_0 + \beta_i X_{it} + \varepsilon_{it} \quad (7)$$

Where Y_{it} represents the endogenous variable, X_{it} is the set of explanatory variables, β_0 is the constant term, β_i encompasses the parameters, and ε_{it} is the error term. The specific modeling focuses solely on the specification of the error term ε_{it} . The basic form can be expressed simply as:

$$\varepsilon_{it} = u_i + v_t + w_{it}$$

Where u_i represents a term that is constant over time and depends only on individual i , v_t is a term that depends only on the period t , and w_{it} is a cross-sectional random term.

This study aims to analyze the determinants of inclusion within the WAEMU region. The literature on measuring financial inclusion and analyzing its determinants, although relatively new, continues to grow. Based on the results obtained in previous studies, notably those conducted by Gebrehiwot and Makina (2019) and Evans and Adeoye (2016), our empirical model is given by the following panel equation:

$$\begin{aligned} fincl_{it} = & \lambda_0 + \lambda_1 \log GDP_{it} + \lambda_2 Remittances_{it} + \\ & \lambda_3 Pub_spend_{it} + \lambda_4 Consumption_{it} + \lambda_5 Educ_{it} + \lambda_6 Phone_{it} + \\ & + \lambda_7 FBCF_{it} + \lambda_8 Rural_pop_{it} + \varepsilon_{it} \end{aligned} \quad (8)$$

$$i = 1, \dots, N \text{ et } t = 1, \dots, T$$

Where i refers to the country and t denotes the period from 2007 to 2020; $Access_{it}$, Use_{it} , $Prix_Access_{it}$ represent access, use, and price accessibility of financial services, respectively; and ε is the error term. A complete list enumerating the definition and source of each variable used in our estimation is provided in Table 1.

2.3. Data source

The data used in this research primarily consists of secondary data related to macroeconomic variables. Most of this data, particularly the explanatory variables, was collected from the World Bank database (World Development Indicators 2021). As for the financial inclusion variables, they all come from the BCEAO database (2021). This data pertains to the eight (08) countries of the West African Economic and Monetary Union (WAEMU) and covers the period from 2007 to 2020, depending on the availability of certain relevant data for this research. Table 1 below presents the various variables of our study, their description, and their sources.

Table 1. Summary of variables and data sources

Variable	Notation	Description	Data Source
Financial Inclusion Index	IFI	Composite index of the seven (7) financial inclusion variables	Author
Financial Inclusion	TGPSFd	Overall demographic penetration rate of financial services	BCEAO
Financial Inclusion	TGPSFg	Overall geographic penetration rate of financial services	BCEAO
Financial Inclusion	TBS	Strict banking rate	BCEAO
Financial Inclusion	TBE	Expanded banking rate	BCEAO
Financial Inclusion	TGUSF	Overall usage rate of financial services	BCEAO
Financial Inclusion	TIN_c	Nominal interest rate on deposits	BCEAO
Financial Inclusion	TIN_d	Nominal interest rate on loans	BCEAO
Financial Inclusion	Access	Index of access to formal financial services	Author
Financial Inclusion	Use	Index of usage of formal financial services	Author
Financial Inclusion	Price_access	Price accessibility index of formal financial services	Author
Income per Capita	logGDP	Logarithm of income per capita	WDI
Education Level	Educ	Gross enrollment ratio at the primary level	WDI
Remittances	Remittances	Remittances from migrants as a percentage of GDP	WDI
Rural Population	Rural_pop	Share of the population living in rural areas	WDI
Final Consumption	Consumption	Final household consumption expenditures as a percentage of GDP	WDI
Gross Fixed Capital Formation	FBCF	Gross fixed capital formation as a percentage of GDP	WDI
Public Expenditures	Pub_spend	Public expenditures as a percentage of GDP	WDI
Access to Mobile Phones	Phone	Percentage of the population with access to mobile telephony	WDI

Source: Authors.

2.4. Estimations methods

In the existing empirical literature, several studies on the determinants of financial inclusion have relied on a simple panel approach (OLS) (Raichoudhury, 2020; Toxopeus and Lensink, 2007), and/or dynamic panels (ARDL, GMM) (Oyelami et al., 2017; Evans and Adeoye, 2016; Detragiache et al., 2006). However, to conduct this study, we use the generalized least squares (GLS) and random effects (RE) estimator to identify the determinants of financial inclusion in the West African Economic and Monetary Union (WAEMU). In order for GLS results be valid, the number of study years (T) must be at least as large as the sample size (number of countries N), as there must be at least as many observation periods as panels (Greene, 2012; Beck and Katz, 1995).

In our study, we have a sample of eight countries and a study period of thirteen (13) years, covering the period from 2007 to 2020. This estimation method also makes it possible to resolve heteroscedasticity problems.

3. Results and discussions

3.1. Preliminary Tests

3.1.1. Unit Root Test

In the context of this research, we use the Maddala and Wu (1999) unit root test. The choice of this test is justified by the fact that it does not necessarily require the panel to be balanced, as our panel is unbalanced (due to missing data in the education variable). The results of the Maddala and Wu (1999) unit root test (see Appendix 3) show that, on one hand, the variables, particularly public expenditures (Pub_spend) and the proportion of the rural population (Rural_pop), are stationary at level, hence integrated of order 0. On the other hand, the results indicate that the variables such as the financial inclusion index (IFI), final household consumption expenditures (Consumption), remittances from migrants (*Remittances*), the logarithm of income per capita (logGDP), education level (Educ), and access to mobile telephony (Phone) are stationary in first difference, hence integrated of order 1.

3.1.2. Multicollinearity Test

This test aims to prevent an explanatory variable in our model from being a linear combination of one or more other explanatory variables included in the same model. To this end, we detected that there is multicollinearity between, on one hand, the logarithm of income per capita (logGDP) and the proportion of the rural population (Rural_pop); and on the other hand, remittances from migrants (*Remittances*) and the logarithm of income per capita (logPIB).

3.2. Empirical results on the determinants of financial inclusion in the WAEMU

In this section, we first focus on presenting the results obtained from our estimates using the Generalized Least Squares (GLS) method on the determinants of the composite index of financial inclusion and the dimensions of accessibility and usage of financial services.

Secondly, we discuss the various results regarding the determinants of access and usage indicators of financial services in the WAEMU. Finally, thirdly, we present the robustness test results obtained through the random effects (RE) model.

3.2.1. Determinants of the Composite Index and Dimensions of Financial Inclusion in the WAEMU

In this section, we present, through Table 2, the results of our estimates using the Generalized Least Squares (GLS) method on the determinants of the composite index of financial inclusion, the accessibility of financial services, and the usage of financial services. It presents the coefficients of the variables, their standard deviations, and their significance. The Wald diagnostic test confirms the rejection of the null hypothesis, which states that the overall models are not significant. Thus, our models fit the data used in the study properly.

The results of our estimates reveal that income per capita (logGDP) positively and significantly affects not only overall financial inclusion but also, and importantly, the accessibility and usage of financial services by the populations of the WAEMU region. This finding regarding the role of income per capita on the inclusion capacities in the formal financial system is consistent with the theoretical and empirical literature presented above. Indeed, according to the financial liberalization theory developed by Kinnon and Shaw (1973), savings are a growing function of the economic growth rate. Empirically, these results align with those obtained by several authors in recent studies (Mhlanga and Denhere, 2020; Raichoudhury, 2020; Wokabi and Fatoki, 2019; Gebrehiwot and Makina, 2019). An increase in households' disposable income enhances their capacity to save and consequently their access to the formal financial system and the use of financial products and services offered to them.

Additionally, our results suggest that the level of education positively influences access to, usage of financial services, and overall financial inclusion of the populations. Thus, an educated population may better understand the importance and role of the financial system and engage with it. These results corroborate findings from certain researchers (Abdu and Adem, 2021; Mhlanga and Denhere, 2020; Dar and Ahmed, 2020; Abel et al., 2018; Lanie, 2017).

Our results also indicate that gross fixed capital formation positively influences overall financial inclusion, particularly the accessibility of formal financial services to populations in the WAEMU region. This result aligns with the argument supported by Gurley and Shaw (1967). According to them, the division of labor and the techniques for transferring savings into investment are fundamental determinants of financial development. Furthermore, our results reveal that access to mobile telephony is a fundamental factor for access to, usage of financial services, and overall financial inclusion in the WAEMU. Therefore, enhancing telecommunications infrastructure could promote inclusion in the formal financial system for a significant portion of the population in the WAEMU region. This result is consistent with findings by Sarma and Pais (2011).

However, our results show that final household consumption expenditures (Consumption) negatively and significantly influence access to, usage of financial services, and overall

financial inclusion of the populations in the WAEMU region. This result highlights the burden of final household consumption expenditures on their inclusion capacities in the formal financial system. Indeed, an increase in final consumption expenditures undermines the possibilities of access to and use of financial services for households in the WAEMU region. In any case, governments would benefit from amplifying efforts in favor of financial education.

Moreover, our results indicate that the share of the population living in rural areas (Rural_pop) negatively and significantly affects the usage dimension of financial services in the WAEMU region. This implies that the distance of populations from various urban centers, which are recognized as having better financial infrastructure, limits their capacity to use financial services in the WAEMU region.

In summary, our results support that, on one hand, income per capita, level of education, and access to mobile telephony positively and significantly affect financial inclusion, particularly the access and usage dimensions of financial services in the WAEMU region. On the other hand, these results indicate that final household consumption expenditures negatively and significantly influence inclusion in the formal financial system of the populations in the WAEMU.

Table 2. Results of Estimates on the Determinants of the Composite Index of Financial Inclusion and Dimensions of Access and Use of Financial Services

VARIABLES	IFI		Access		Use	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>logGDP</i>	0.0403*** (0.0150)		0.0436*** (0.0157)		0.0531* (0.0274)	
<i>Remittances</i>	-0.00246 (0.00282)		-0.00238 (0.00306)		0.0100*** (0.00379)	
<i>Consumption</i>	-0.00569*** (0.00118)	-0.00836*** (0.00177)	-0.00609*** (0.00125)	-0.00403*** (0.00105)	-0.0134*** (0.00215)	-0.00699*** (0.00134)
<i>Educ</i>	0.00161*** (0.000421)	0.000997** (0.000454)	0.00123*** (0.000453)	0.00151*** (0.000489)	0.00911*** (0.000549)	0.00901*** (0.000571)
<i>Pub_spend</i>	-0.00139 (0.00373)	3.19e-05 (0.00485)	-0.00243 (0.00392)	-0.00367 (0.00508)	0.0199*** (0.00583)	0.0196*** (0.00603)
<i>Phone</i>	0.00123*** (0.000172)	0.00107*** (0.000272)	0.00128*** (0.000175)	0.00147*** (0.000244)	0.00153*** (0.000462)	0.00162*** (0.000340)
<i>FBCF</i>	0.00593*** (0.00158)	0.00361** (0.00178)	0.00693*** (0.00168)	0.00922*** (0.00183)	-0.000696 (0.00284)	0.00299 (0.00230)
<i>Rural_pop</i>		-0.00168 (0.00117)		0.000342 (0.00114)		-0.00382*** (0.00138)
Constant		0.701*** (0.219)				
Wald chi2(4)	316.61	99.86	159.57	137.15	2486.91	2407.49
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	81	81	81	81	81	81
Nombre de pays	8	8	8	8	8	8

Standard deviations are shown in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$: indicate significance levels of 1%, 5%, and 10%, respectively

Source: Authors.

In this research, the composite index of financial inclusion in the WAEMU has been constructed from seven (07) indicators, including two (02) for the accessibility dimension of financial services, three (03) for the usage dimension of financial services, and two (02)

for the price accessibility dimension. Therefore, in light of the results presented above, what could be the main determinants of the financial inclusion indicators that measure access to and usage of financial services in the WAEMU?

3.2.2. Determinants of Access and Usage Indicators of Financial Services in the WAEMU

Table 4 below presents our results from the generalized least squares on the determinants of the main indicators of financial inclusion in the WAEMU. Models 1, 2, 3, 4, and 5 highlight the determinants of the overall demographic penetration rate of financial services (TGPSFd), the overall geographical penetration rate of financial services (TGPSFg), the overall usage rate of financial services (TGUSF), the strict banking rate (TBS), and the expanded banking rate (TBE).

Our results revealed that income per capita and access to mobile telephony positively and significantly affect the overall demographic penetration rate of financial services, the overall geographical penetration rate of financial services, the overall usage rate of financial services, and the strict banking rate. These results once again confirm the conclusions of previous studies (Mhlanga and Denhere, 2020; Raichoudhury, 2020; Wokabi and Fatoki, 2019; Gebrehiwot and Makina, 2019).

Furthermore, these results support that the level of education positively and significantly influences the overall geographical penetration rate of financial services, the overall usage rate of financial services, the strict banking rate, and the expanded banking rate. Thus, our results align with the conclusions of certain earlier studies, particularly (Abdu and Adem, 2021; Mhlanga and Denhere, 2020; Dar and Ahmed, 2020; Abel et al., 2018; Lanie, 2017).

However, our results indicate that final household consumption expenditures have a negative and significant influence on the overall demographic penetration rate of financial services, the overall geographical penetration rate of financial services, the overall usage rate of financial services, the strict banking rate, and the expanded banking rate. This means that an increase in the final consumption expenditures of populations limits the capacity of economic agents to save and consequently restricts their inclusion in the formal financial system.

Moreover, our results show that the share of the population living in rural areas (rpop) negatively affects the financial inclusion of populations. However, this negative effect of the share of the population living in rural areas is only significant on the overall usage rate of financial services and the expanded banking rate in the WAEMU. Thus, an increase in the proportion of the population living in rural areas reduces the ability of these populations to appropriately use formal financial services. This could be explained by the high concentration of financial institutions in urban centers and, more importantly, the inadequate telecommunications infrastructure in rural areas of the WAEMU. This finding aligns with the conclusions reached by Wokabi and Fatoki (2019). The results of the determinants of the different access and usage indicators of financial services in the WAEMU are recorded in Table 3 below.

Table 3. Results of the determinants of Access and Usage Indicators of Formal Financial Services

VARIABLES	TGPSFd		TGPSFg		TGUSF		TBS		TBE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>logPIB</i>	10.32** (5.163)		3.088 (6.815)		7.304*** (2.293)		2.268** (0.884)		1.549 (2.190)	
<i>Remittances</i>	-0.878 (0.869)		-1.755 (1.892)		0.928*** (0.319)		0.245** (0.122)		1.086*** (0.297)	
<i>Consumption</i>	-1.433*** (0.429)	-2.227*** (0.569)	-1.624*** (0.438)	-6.330*** (1.367)	-1.462*** (0.150)	-0.835*** (0.125)	-0.383*** (0.0692)	-0.227*** (0.0446)	-0.678*** (0.167)	-0.376*** (0.107)
<i>Educ</i>	0.152 (0.124)	0.0170 (0.130)	1.104*** (0.294)	3.084*** (0.757)	0.690*** (0.0569)	0.699*** (0.0575)	0.277*** (0.0177)	0.280*** (0.0187)	0.741*** (0.0518)	0.740*** (0.0476)
<i>Pub_spend</i>	0.0460 (1.341)	-0.283 (1.492)			2.053*** (0.466)	2.092*** (0.585)	0.577*** (0.188)	0.395** (0.198)	0.182 (0.464)	0.941* (0.518)
<i>Phone</i>	0.463*** (0.0711)	0.452*** (0.0907)	0.425*** (0.135)	1.562*** (0.340)	0.231*** (0.0422)	0.285*** (0.0330)	0.0308** (0.0149)	0.0596*** (0.0112)	0.0653** (0.0294)	0.0374 (0.0306)
<i>FBCF</i>	1.684*** (0.526)	1.077** (0.549)	1.494** (0.729)	11.66*** (2.774)	0.207 (0.247)	0.816*** (0.225)	-0.189** (0.0916)	-0.0481 (0.0818)	0.170 (0.187)	0.426** (0.179)
<i>Rural_pop</i>		-0.198 (0.374)		-0.233 (1.383)		-0.331** (0.134)		-0.00677 (0.0491)		-0.406*** (0.112)
<i>Interest_rate</i>			1.470 (1.230)							
Constant		179.2** (69.88)								
Wald chi2(6)	188.27	95.75	81.47	101.13	2021.73	2043.28	2477.76	2268.49	1839.83	1961.19
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	81	81	74	88	81	81	81	81	81	81
Nombre de pays	8	8	8	8	8	8	8	8	8	8

Standard deviations are shown in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$: indicate significance levels of 1%, 5%, and 10%, respectively.

Source: Authors.

In any case, we can assert that, on the one hand, income per capita, the level of education, and access to mobile telephony positively and significantly affect the accessibility and usage of financial services in the WAEMU region. On the other hand, these results support that final household expenditures negatively and significantly influence access to and usage of formal financial services among populations in the WAEMU region.

3.2.3. Robustness Test: Estimation Using the Random Effects Method (RE)

We test the robustness of our results by changing the estimation method. Indeed, we replace the generalized least squares (GLS) method with the random effects (RE) method. The results recorded in Table 4 confirm the previous results. In fact, an improvement in the level of education, as well as access to mobile telephony, positively and significantly affects financial inclusion (IFI, Access, Usage, TGPSFd, TGPSFg, TGUSF, TBS, and TBE) in the WAEMU region. However, these results support that final household expenditures negatively and significantly influence financial inclusion in the WAEMU region.

Table 4. Robustness tests on the Determinants of Financial Inclusion in the WAEMU

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	<i>IFI</i>	<i>Access</i>	<i>Use</i>	<i>TGPSFD</i>	<i>TGPSFG</i>	<i>TGUSF</i>	<i>TBS</i>	<i>TBE</i>
<i>logGDP</i>	0.0247 (0.0593)	0.0421 (0.0725)	0.0492 (0.0543)	2.513 (17.73)	60.41 (93.36)	15.48* (8.369)	1.914 (1.690)	7.142 (7.791)
Remittances		-0.00400 (0.00681)	0.0103** (0.00510)					
<i>Consumption</i>	-0.00796*** (0.00277)	-0.00651 (0.00459)	-0.0137*** (0.00344)	-2.103** (0.829)	-13.02*** (5.027)	-1.181*** (0.307)	-0.301*** (0.0790)	-1.023*** (0.231)
<i>Educ</i>	0.00172** (0.000736)	0.00159* (0.000926)	0.00907*** (0.000694)	0.200 (0.220)	2.656** (1.127)	0.407*** (0.118)	0.283*** (0.0210)	0.316*** (0.0994)
<i>Pub_spend</i>	-0.00211 (0.00867)	-0.00226 (0.0105)	0.0195** (0.00785)	-1.044 (2.592)	-5.917 (20.93)	1.526** (0.732)	0.567** (0.247)	0.416 (0.518)
<i>Phone</i>	0.00120** (0.000592)	0.00128* (0.000688)	0.00155*** (0.000516)	0.473*** (0.177)	1.338* (0.772)	0.293*** (0.0474)	0.0394** (0.0169)	0.143*** (0.0333)
<i>FBCF</i>	0.00642* (0.00342)	0.00879* (0.00455)	-0.000835 (0.00341)	2.099** (1.021)	10.66 (11.72)	0.276 (0.319)	-0.128 (0.0973)	0.246 (0.222)
Constant	0.295 (0.587)	-0.00806 (0.869)	0.0553 (0.651)	110.2 (175.4)	360.3 (1.051)	-47.43 (77.06)	-6.161 (16.72)	24.07 (66.44)
Wald chi2(4)	61.77	50.61	434.58	55.79	952.50	250.76	362.80	183.65
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	81	81	81	81	81	81	81	81
Nombre de pays	8	8	8	8	8	8	8	8

Standard deviations are shown in parentheses; *** p<0.01, ** p<0.05, * p<0.1: indicate significance levels of 1%, 5%, and 10%, respectively.

Conclusion

The purpose of this paper was to investigate the determinants of financial inclusion in the WAEMU. To this end, our study used the generalized least squares (GLS) and random effects (RE) methods. The results of our estimations revealed that per capita income, level of education, access to mobile telephony and gross fixed capital formation positively and significantly affect financial inclusion as a whole, as well as the dimensions of access to and use of formal financial services in the WAEMU. Our results also supported that income per capita, access to mobile telephony, and the level of education positively and significantly influence the overall demographic penetration rate of financial services, the overall geographic penetration rate of financial services, the overall usage rate of financial services, and the strict banking rate in the WAEMU. In any case, increasing income per capita, access to mobile telephony, and access to education promote inclusion in the formal financial system for populations in the WAEMU region.

In contrast, the results revealed that household final consumption expenditures negatively and significantly affect the overall demographic penetration rate of financial services, the overall geographic penetration rate of financial services, the overall usage rate of financial services, the strict banking rate, and the expanded banking rate. Additionally, our results show that the share of the population living in rural areas negatively affects financial inclusion. However, this negative effect of the rural population is only significant for the overall usage rate of financial services in the WAEMU. Furthermore, the results of our estimations indicated that the share of the rural population negatively affects the use of formal financial services in the WAEMU. This result could be attributed to the lack of adequate infrastructure in rural areas, which is necessary to attract investors from the financial sector to these regions.

Today, banking and financial innovations significantly contribute to the financial inclusion process. The importance of these innovations, combined with the commitment of monetary authorities to financial inclusion, raises questions regarding the effects of financial inclusion on monetary policy.

Notes

- ⁽¹⁾ See the appendix 2 for the weight of each dimension in constructing the synthetic financial inclusion index within the WAEMU region.
- ⁽²⁾ In this study ifi1, ifi2 and ifi3 represent, respectively, access (Access), usage (Usage), and price accessibility (Price_Access) of financial services.

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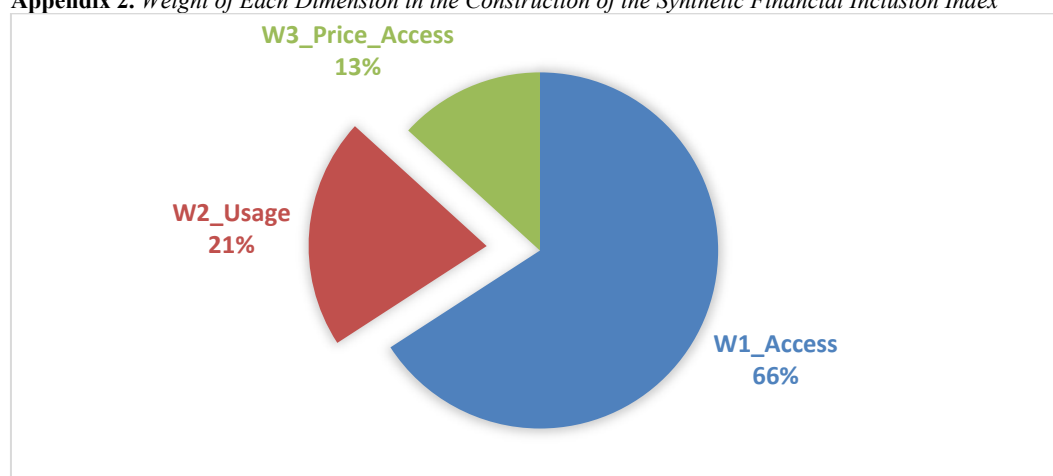
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Appendix

Appendix 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev,	Min	Max
<i>IFI</i>	112	0,1120038	0,133644	0,0145144	0,8785856
<i>Access</i>	112	0,0792997	0,1459152	0,0001223	1
<i>Use</i>	112	0,4163729	0,2432307	0	0,9930962
<i>Price_access</i>	112	0,5115577	0,1893464	0,1427221	0,8683478
<i>logGDP</i>	112	6,689779	0,4512376	6,032479	7,752656
<i>remittances</i>	112	4,615222	3,332478	0,5277326	10,82203
<i>consumption</i>	111	88,33789	6,70341	74,51981	109,533
<i>Pub_spend</i>	103	13,77244	2,777646	7,122182	20,24348
<i>Interest_rate</i>	88	1.839805	4.427838	-23.13794	7.623044
<i>FBCF</i>	111	21,46655	5,959995	6,699039	32,64794
<i>Rural_pop</i>	112	62,28415	10,4417	48,294	83,792

Appendix 2. Weight of Each Dimension in the Construction of the Synthetic Financial Inclusion Index



Appendix 3. Maddala and Wu unit root test

Variables	At level		First difference		Decision
	No trend	With trend	No trend	With trend	
<i>ifi</i>	1.1146	2.8493	44.2635***	60.2181***	I (1)
<i>Access</i>	1.1027	3.1357	44.7112***	59.4489***	I (1)
<i>Use</i>	4.1622	8.0664	44.2635***	60.2181***	I (1)
<i>Remittances</i>	15.8105	20.4353	73.7325***	49.0165***	I (1)
<i>logGDP</i>	4.0447	17.6323	85.9525***	60.4257***	I (1)
<i>FBCF</i>	36.4870***	30.7719**	-	-	I (0)
<i>Phone</i>	39.7676 ***	16.6936	65.1258	49.6324	I (1)
<i>Pub_spend</i>	36.2243***	24.7304*	-	-	I (0)
<i>Consumption</i>	23.2343	25.9849*	124.1947***	82.8966***	I (1)
<i>Rural_pop</i>	12.6977	33.7451***	-	-	I (0)
<i>Educ</i>	35.1308***	5.0363	23.9147**	18.9909	I (1)