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Exploring Digital Financial Determinants Effect on Financial Inclusion and Economic Resilience: Insights from Sub-Sahara Africa

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Abstract

A large population of sub-Sahara Africa has no or limited access to financial systems and products that are considered important for social development, financial inclusion, and economic resilience. The lack of access to financial systems causes a big concern as it is considered one of the sources of inequalities in these emerging countries. It becomes a priority for these countries as access to financial systems is considered a driver of financial inclusion conducive to economic growth and poverty reduction. However, progress in recent years has had a limited impact on financial inclusion and economic resilience objectives. This study evaluates the contribution of the traditional factor and the digital effect on financial inclusion and economic resilience of sub-Saharan Africa. We analyze financial inclusion data from 23 countries in sub-Saharan Africa. The results attest to digital determinants' positive and significant impact on financial inclusion and economic resilience in this region. It also revealed that mobile financial transaction determinants positively and significantly affect economic resilience. Conversely, domestic credit and inflation are negatively associated with economic resilience. This study makes a theoretical contribution to the literature and has practical implications for policymakers and governments that promote financial inclusion and economic resilience in these regions.

Keywords

Financial Inclusion, Economic Resilience, Digitization, Sub-Saharan Africa, Dynamic Panel

1. Introduction

The economic stimulus measures initiated around the world in response to the

COVID-19 and Ukrainian crises have brought back into focus the importance of financial inclusion and the ability of underdeveloped economies to react to economic fluctuations (Adedokun & Ağa, 2023; Ahmad et al., 2020). These economies are characterized mainly by underdeveloped financial systems that impede the development of these countries. Inclusive financial systems therefore help strengthen economic resilience through savings and investments that ensure optimal capital allocation (Ali et al., 2021; Anarfo et al., 2019). It promotes economic resilience which can be defined as the ability to recover from or adapt to the negative effects of economic shocks (Svoboda & Applová, 2016). It helps foremost countries cope with economic crises for quick recovery as it contributes to income distributions and facilitates support to investment (Egidi & Salvati, 2020). To that end, it incorporates two dimensions: the extent to which economic shocks are cushioned and the speed with which countries return to normal after a shock. Many studies have highlighted the importance of studying the link between financial inclusion and economic resilience (Kamwa, 2022; Ali et al., 2021; Anarfo et al., 2019). Inferences from those studies have been about the understanding of policies related to strengthening financial inclusion and the ability of economies to respond to inherent fluctuations.

Studies of Asongu and Nwachukwu (2019) have suggested that financial inclusion policies aim to provide formal financial services tailored to meet the needs of the underprivileged to improve their well-being. Billio et al. (2020) pointed out that financial inclusion could help strengthen economic resilience in times of crisis, particularly by reducing transaction costs, increasing the efficiency of payment methods, and enhancing security of transfers. In sub-Saharan Africa, having a bank account is certainly an entry point into the formal financial system (Ahmad et al., 2020). It makes it easier and often more affordable for account holders to pay bills, receive payments and send or receive funds. It secures savings and ensures access to bank loans. Consequently, having a bank account in sub-Sahara Africa is an indicator of financial inclusion (Avom et al., 2021). To that extent, Demirguc-Kunt et al. (2018) showed that, 71% of the adult population contributes to national savings in the world high-income economies versus 43% in African low-income economies. On a more specific level, most of the sub-Sahara African population faces several difficulties such as illiteracy, lack of financial means, lack of documentation to open bank account, remoteness from physical infrastructure. The difficulties hamper their access to financial services (Pazarbasioglu et al., 2020). Moreover, most of this population are favouring more and more the use of mobile financial services over traditional banking due to several factors including the ease of opening an account[1] and the lower transaction costs (Della Peruta, 2018).

The literature shows that financial inclusion is supposed to reduce poverty and stimulate economic growth and understanding its determinants is a key for strengthening the resilience of African economies (Avom et al., 2021). To that,

[1]Without to need for administrative documents that are difficult to obtain.

Zins and Weill (2016) reported a low level of financial inclusion in sub-Saharan Africa that constitutes a foundation for economic resilience. They indicate that socio-economic factors such as gender, income level and education would help improve the level of financial inclusion, with a greater marginal effect for income and education. Their results show that, in terms of policies to boost financial inclusion, women and young people are best targeted. Although previous studies provide some evidence on the determinants of financial inclusion in developing countries, to our knowledge there is no empirical evidence assessing financial inclusion as an instrument of economic resilience in sub-Saharan Africa (Avom et al., 2021; Zins & Weill, 2016; Ahmad et al., 2020). Therefore, there is a need to obtain a better understanding of financial inclusion factors on economic resilience.

This study examines these factors that contribute to financial inclusion in addition to economic resilience in order to comprehend the low level the penetration of bank penetration and the size of the informal sector. In the sub-Saharan African countries, the informal sector accounts for a significant share of employment, with nearly 70% of the wealth of these nations (IMF[2], 2017). Nevertheless, economic agents from this sector are generally excluded from the formal banking system. Avom et al. (2021) indicate to that extent that almost 80% of the adult African population has no access to formal banking and around 34% has an account with a formal financial institution. However, despite significant progress in mobile money development in recent years, notably with a high mobile money penetration rate, financial inclusion remains a major challenge in sub-Saharan Africa. This is due to low levels of access to and use of basic financial services[3]. According to Global Findex Database (2017), four hundred million adults do not have access to or use formal financial services in sub-Saharan Africa.

The African economies remain highly dependent on bank financing, the rate of people holding bank accounts and having access to bank credit remains very low (Avom et al., 2021). Households in these countries are very often unable to use the banking sector to smooth their income. However, since 2014, there has been an increase in financial inclusion, essentially driven by digital determinants such mobile payment systems. Indeed, data used by Global Findex Database (2022) reveals a breakthrough of this technology towards the west of the continent after its initial growth in East Africa. In Senegal, for example, in 2019, only 6% of adults had an electronic money account, compared with 32% today. In other words, demand for electronic money is booming. Sub-Saharan Africa, with a population of over one billion[4], with half of whom will be under the age of 25 by 2050, has economies that do not share the same currency. The region is heterogeneous in terms

[2]International Monetary Fund.

[3]Materialized by geographical banking coverage that remains limited and around 3 ATMs per 100,000 inhabitants, compared with the developing country average of 19.6 ATMs per 100,000 inhabitants.

[4]With a market of 1.2 billion people and the creation of the world's largest free trade zone, the continent is embarking on a radically new development path that will harness the potential of its people and resources.

of size (population), wealth (GDP), natural and cultural endowments[5] (Kamwa, 2020). The diversity, the human and natural resources of the region have considerable attributes to generate inclusive growth and reduce poverty. Moreover, the economic and structural disparity observed in these economies, and from the results of the studies conducted by Avom et al. (2021) and Klapper and Lusardi (2019) revealed a link between financial inclusion and resilience in sub-Saharan African economies. These economies are more exposed to external shocks due to their economic structure, and do not always benefit from mechanisms such as the size of the population, the degree of economic diversity, the ability to implement a counter-cyclical economic policy or the development financial markets enabling them to properly deal with such external surprises (Kamwa, 2022).

Fouejieu et al. (2020) highlight the significant contribution of digital financial services such as electronic money or point-of-sale payment to economic resilience during COVID-19 pandemic. Therefore, this study intends to examine the influence of digital factors such as mobile payment in addition to the traditional determinant of financial inclusion on economic resilience (Ibrahim & Alagidede, 2018; Matekenya et al., 2021; Alhassan et al., 2019). The present study is therefore a contribution to the literature on the effect of financial inclusion on economic resilience. The aim is to formulate policy implications for financial inclusion contributions to economic resilience. This objective is motivated by the increased use of "Mobile Money", which today contributes to reinforcing the level of financial inclusion in sub-Saharan Africa[6] (French Development Agency, 2020).

The remainder of the paper is organized as follows. Section 2 presents the literature and the theoretical background on financial inclusion and economic resilience. Section 3 describes the methods and the measures used in this analysis. Section 4 presents the empirical results and findings followed by additional analysis. Section 5 concludes with some policy implications.

2. Financial Inclusion and Economic Resilience in Sub-Saharan Africa

Theoretical background highlights the link between financial inclusion and economic resilience in sub-Saharan Africa (Kling et al., 2022). Research has demonstrated the importance of studying the determinants of financial inclusion, notably through the identification of measurement indicators, on the one hand, Avom et al. (2021), and the understanding of economic policies linked to the strengthening of financial inclusion, on the other hand (Guérineau & Jacolin, 2014).

Allen et al. (2016) analyzed the foundations of financial inclusion to understand the endogenous factors linked to holding or using bank accounts in formal financial institutions. The study demonstrated how improved financial inclusion is linked to a framework aimed at facilitating people's access to financial services, proximity to financial institutions and macroeconomic stability. Similarly, Efobi

[5]Culture highlights the level of awareness of society, the different languages used (French, Spanish and Portuguese) and the history of economic and political events.

[6]From 55.5% to 60.1% between 2018 and 2019.

et al. (2014) explore the factors influencing access and use of banking services in Nigeria, and reported that income, use of information and information technologies have some influence financial inclusion in sub-Saharan Africa.

2.1. Backgrounds Review

Financial inclusion plays a fundamental role in strengthening economic resilience, particularly in Africa where exogenous shocks (climatic, health, economic) are frequent (Moore et al., 2019). It acts through several transmission channels that are based on solid theoretical foundations and find concrete empirical applications.

The first channel is based on credit constraint theory (Stiglitz & Weiss, 1981). According to this theory, information asymmetries prevent poor populations from accessing formal credit. Indeed, in African economies, a large portion of the population is excluded from the formal financial system, making shock management difficult. However, financial inclusion, by expanding access to credit and savings, helps mitigate this vulnerability.

The second channel stems from Modigliani and Brumberg's (1954) model of intertemporal consumption. According to this model, by facilitating savings, financial inclusion improves the management of irregular income, frequent in African informal economies. Demirgü-Kunt et al. (2018) show that increased access to bank accounts and mobile services improves savings capacity and reduces economic vulnerability in several African countries. Indeed, financial inclusion enables individuals and small and medium-sized enterprises to access financial products (credit, savings, insurance), reducing liquidity constraints. This helps them to invest in productive activities, cushion economic shocks and maintain stable consumption.

The third channel draws on Briguglio et al.'s (2009) theory of economic resilience, which highlights the capacity of systems to absorb shocks. Financial products such as climate insurance and mobile money transfers strengthen this capacity. Similarly, investment in financial assets and risk management are channels through which financial inclusion contributes to improving economic resilience, particularly by reducing income inequality among poor households (Matekenya et al., 2021; Kling et al., 2022). Empirical research shows that the adoption of mobile money has enabled many African households to escape poverty and better respond to economic shocks, thanks to savings and transfers. Jack and Suri (2014), through a study of Kenya, show that the M-Pesa system has enabled 2% of Kenyan households to escape poverty thanks to mobile money savings. This system also strengthened resilience to shocks by facilitating emergency transfers between households.

Sen's (1999) capability approach identifies the channel of economic empowerment. According to this approach, financial inclusion strengthens individual freedoms by broadening economic choices. Indeed, access to financial services increases households' ability to adapt to economic change, reduce their vulnerability

and engage in long-term development strategies. In particular, financial inclusion gives women, young people and rural populations access to appropriate financing tools, thereby strengthening their autonomy and ability to bounce back after a shock. Indeed, mobile banking services targeting women, such as M-Kopa present in several African countries, are a concrete example. In the same vein, studies by Ndlovu and Toerien (2020) demonstrate that access to financial services has a positive influence on households' social standing, as well as their level of effective risk management and entrepreneurial development opportunities.

Inclusive growth theory, on the other hand, highlights the channel for post-crisis recovery and macroeconomic stability (OECD, 2012). According to this theory, financial inclusion stimulates post-crisis recovery by supporting small and medium-sized enterprises, as well as local investment. For Sulong and Bakar (2018), financial inclusion contributes to the economic performance of African households through the deployment of bank branches and the reduction of constraints linked to accessibility to financing.

Finally, the social transfer and digital payments channel draws on Thaler and Sunstein (2008) behavioral economics. This theory shows that digital financial tools can correct certain behavioral biases, such as procrastination when it comes to savings. Indeed, structured financial services help individuals overcome cognitive biases, such as a preference for immediacy, which limit their ability to plan, save, or invest.

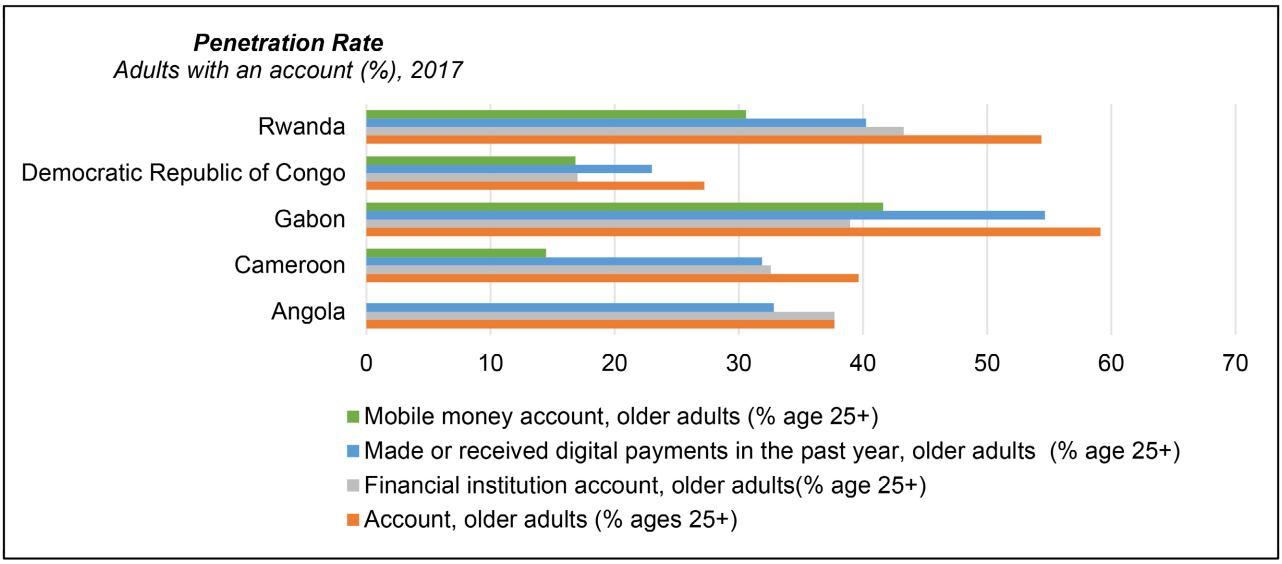
In summary, these different channels show that financial inclusion, beyond its immediate economic role, contributes profoundly to structuring societies that are more resilient to crises. Its expansion in Africa, particularly through digital technologies, therefore constitutes a strategic lever for the continent's economic resilience (Shi et al., 2021; Fouejieu et al., 2020).

2.2. Insights on Financial Inclusion in Sub-Saharan Africa

Financial inclusion fosters economic development by enabling a growing proportion of households and small and medium-sized enterprise (SMEs) to access a wide range of financial services at reasonable cost. However, it appears to be the weakest in sub-Saharan Africa, and particular in the Franc Zone, in terms of bank penetration, intensity of use of bank accounts and access to credit. The prevalence of financial exclusion in sub-Saharan Africa reflects structural factors stemming from shortcomings in supply (cost, management of information asymmetries), and demand for financial services (income and financial education, self-exclusion phenomena), the regulatory environment and the business climate. However, as with any development of financial inclusion activities, this implies new risks for financial stability, and therefore a strengthening of regulations and banking supervision so that public confidence and growing access to financial services go hand in hand with stable, sustainable economic growth.

Figure 1 generates with Global Findex 2017 data on the use of digital factors such mobile money, digital payments, showed that bank account ownership varies

considerably between Central African countries. We see that in 2017, in Gabon, 59% of adults reported having a bank account, compared with 54% in Rwanda, 40% in Cameroon and 38% in Angola. By contrast, only 27% reported having one in the Democratic Republic of Congo.



Source: by the author based on data from the Global Findex database.

Figure 1. Bank penetration rates in Central Africa.

Notwithstanding the observed low level of access to banks, which is essentially explained by low per capita income, **Figure 1** above also highlights a remarkable enthusiasm among households for mobile payment. The emergence of this phenomenon[7], over the last five years, however, means that we need to redefine the notion of banking, which must now consider other innovative means such as mobile payment accounts. These should be part of the development programs and strategies of countries wishing to maximize the number of people with access to banking services, and consequently improve their level of financial inclusion. The International Monetary Fund (IMF, 2023) indicated that financial inclusion reflects to the ability of individuals and businesses to access a range of financial products and services[8] that are affordable, useful, tailored to their needs and offered by reliable and responsible providers.

Access to financial services is considered by the institution as a factor of progress for seven of the United Nations' 17 Sustainable Development Goals[9]. For the World Bank Group, it is therefore an essential factor in reducing poverty and promoting shared prosperity. Access to financial products and services makes every-

[7]According to the Findex Global database report, mobile payment account penetration rates of 10% or more worldwide are observed 13 countries, all of which are located in sub-Saharan Africa.

[8]Transactions, payments, savings, credit, insurance.

[9]The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by the United Nations in 2015. They are a global call to action to eradicate poverty, protect the Planet and ensure that all human beings live in peace and prosperity by 2030.

day life easier for economic functioning, and helps households and businesses anticipate the financing of long-term projects or deal with unforeseen circumstances. An individual with a current bank account is more likely to use other financial services, such as credit or insurance, to set up or expand a business, to invest in education or health, to manage risk and overcome financial shocks. These are all factors likely to improve living standard. In Kenya, for example, the "M-pesa" service has enabled the rapid development of mobile money, with a coverage rate of almost 78% of the population (Economist Intelligence Unit, 2016). This is also the case in Uganda and Tanzania, where mobile money has enabled rural populations to save their agricultural income and carry out their transactions securely without being limited by distance and cost.

Figure 2 shows the level of traditional and digital financial inclusion in 2021 in the economies of sub-Saharan Africa. It shows that African nationals are very keen to have mobile money and deposit accounts. Sub-Saharan Africa remains at the forefront of one of the most exciting development innovations of our time, notably with the rise of mobile money (Alhassan et al., 2019). This technology is helping increase the use of financial services and the financing of activities in the informal sector. We are also observing a breakthrough of this technology towards the west of the continent, following its initial boom in East Africa. Informal savings groups, such as "tontines", are very popular, and when households need to borrow money, they turn not to their banker, but to friends and relatives.

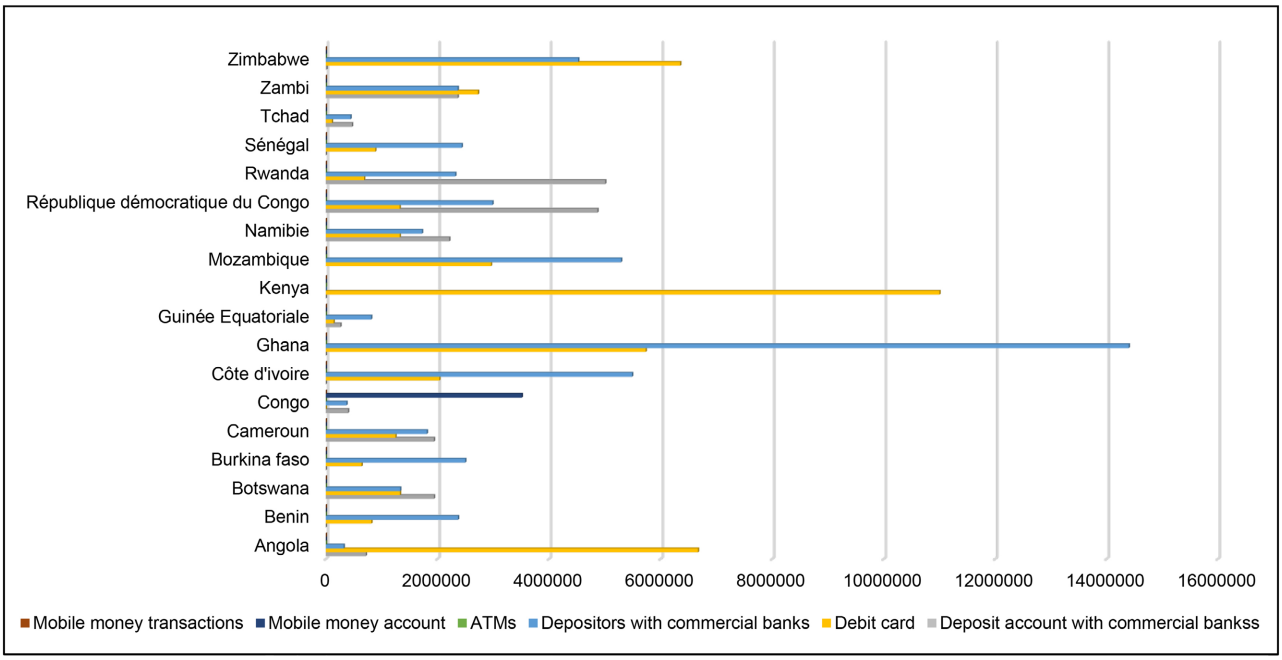


Figure 2. State of financial inclusion in sub-Saharan Africa.

Sub-Saharan Africa includes both upper- and lower-middle-income countries, as well as high-income countries. There are 22 fragile or conflict-affected countries, and 13 small, sparsely populated states with limited territory and human

capital. However, growth conditions remain insufficient to reduce extreme poverty and stimulate shared prosperity in the medium and long term. However, today's slow recovery observed in per capita income in the region is still not sufficient to accelerate poverty reduction and return the region to its pre-COVID-19 pandemic trajectory. Sub-Saharan Africa's economic performance is not uniform from country to country.

The real gross domestic product growth in the West and Central Africa subregion is expected to fall from 3.7% in 2022 to 3.4% in 2023, while that of the West and Central African sub-regions will drop from 3.5% to 3%. However, the region's performance has still been dragged down by weaker long-term growth in the continent's largest economies. 0.5% recession has been observed in South Africa due to the worsening of the energy crisis resulting from the war in Ukraine, while Nigeria's growth recovery for 2023 (2.8%) remains fragile due to weak oil production. Among the top ten economies in sub-Saharan Africa, which together account for more than three quarters of the region's GDP, eight (Angola, Ethiopia, Ivory Coast, Kenya, Namibia, Nigeria, Senegal, and South Africa) are currently posting growth rates below their long-term averages.

3. Methodology and Empirical Analysis

There is no single method for measuring economic resilience (Miller et al., 2017). However, most work on the issue proposes an economic resilience index to measure policy adequacy in four main areas, namely macroeconomic stability, microeconomic market efficiency, social development and good governance (Gherghina et al., 2022; Briguglio & Piccinino, 2012). For our study, following the example of Sha'ban et al. (2020); and Sharma (2016), we choose real GDP growth as the indicator for measuring economic resilience. Using a dynamic panel data estimator, we will analyze the impact of conventional and digital financial inclusion on the economic performance of sub-Saharan African countries during the period 2015-2021. However, Hu et al. (2021) highlight potential endogeneity and simultaneity problems, suggesting the use of a dynamic panel GMM[10] estimator. The authors suggested that using the method of generalized moments that traditional financial inclusion contributes to the total productivity of agricultural factors through the transformation of the production mode of poor households. This methodology provides, under some assumptions, solutions to the problems of simultaneity bias, reverse causality and omitted variables

The equation used is as follows:

$$y_{it} = \alpha_j y_{i,t-j} + \beta_1 X_{it} + \beta_2 Z_{it} + \beta_3 W_{it} + \gamma_i + \varepsilon_{it}$$

where i represents the sub-Saharan African country, t is the measurement period, i.e., from 2015 to 2021, γ_i the country random effect, ε_{it} is independent and identically distributed over the whole sample with variance. In this model, the

[10]The Generalized Moments Method (GMM) in dynamic panel provides solutions to the problems of simultaneity bias, reverse causality and omitted variables.

dependent variable y_{it} represents economic resilience, $y_{i,t-j}$ its lagged value.

In this model, we measure financial inclusion through several explanatory variables. Ether X_{it} which corresponds to the set of variables inherent to classic financial inclusion: bank penetration measured by ATMs *per 1000 adults; number of depositors which commercial banks per 1000 adults; number of credit cards per 1000 adults; number of debit cards per 1000 adults and volume of domestic credit by commercial banks*. The Z_{it} variable, covers all the variables relating to access to digital financial services: *the number of active Mobile Money accounts per 1000 adults and the value of Mobile Money transactions (% of GDP).* W_{it} Represents the confounders control variables inherent in economic resilience. These are *the level of inflation, the degree of trade openness, government spending and vulnerable employment*. The data used are provided by the World Bank (WB) and the IMF's Financial Access Survey (FAS).

Based on seven (7) explanatory variables and four (4) control variables, we have selected 23 sub-Saharan African countries, due to the lack of sufficient data for certain countries, relating to traditional and digital financial inclusion (*See Appendix, Table A1 for the list of countries*). Table 1 below shows all the variables used in our model.

Table 1. Presentation and definition of model variables.

N°	Variables	Definition/units of measurement	Source
		DEPENDENT VARIABLES (Yit)	
1	RE = GDP growth (Annual GDP %)	Economic Resilience (ER) can be defined as the ability of an economy to anticipate, resist, adapt and recover quickly from economic disruption. According to Svoboda and Applová (2016), it is the ability of the economy to recover from or adapt to the negative effects of economic shocks. Following the example of (Briguglio & Piccinino, 2012), Nizamani, et al. (2017), we use the GDP growth rate as a proxy variable.	WDI
		INDEPENDENT VARIABLES	
3	Credit card (CRTE)	represents the number of credit cards available and used by African nationals during a given period. Interpretation of this variable will ensure that the availability of payment instruments that can be used in branches or at automatic teller machines (ATM), to carry out basic financial transactions.	FAS-FMI
4	Debit card (DEBCRTE)	financial indicator referring to all active debit cards adopted by individuals living in sub-Saharan Africa during a given period. The interpretation of this variable will also confirm the presence of physical payment tools adapted to the realization of banking operations, whether in a branch or at an ATM.	FAS-FMI
5	Bank depositors (DEPBAQ)	the number of individuals making bank payments to commercial banks.	FAS-FMI

Continued

6	Automatic teller machines (ATM)	geographic variable that looks at the number of ATMs available in the region in sub-Saharan Africa. Automatic Teller Machines are electromechanical devices used to be provided by financial institutions, enabling individuals to carry out their transactions. (withdrawal and deposit of funds) conveniently, quickly and efficiently through their credit cards or debit cards.	FAS-FMI
7	Mobile money accounts Assets (ARGMOB)	refers to the number of active Mobile Money accounts in the African region.	FAS-FMI
8	Mobile money transactions (TMOBIL)	digital financial inclusion variable that determines the volume of transactions carried out by Mobile Money in sub-Saharan Africa during the designated period. These transactions include online bill payments, online shopping, international transfers and much more operations that cannot be carried out quickly, conveniently, and efficiently in a branch.	FAS-FMI
9	Inflation rate (INFL in annual %)	It represents the first control variable of our study. It refers to the upward movement of prices of goods and services, leading to a decline in consumers purchasing power. When the inflation rate is high, it means that households are finding it difficult to gain access to the market for financial services, thus contributing to the economic recession. In the opposite case, when inflation is a low, individuals hold the power to control the economy, thus, contribute to economic growth. Inflation is used to control the sustainability of macroeconomic policy and stabilization concerns. High inflation can affect a government's ability to adapt to the economic and financial cycle.	WDI
10	The volume of bank loans (CREDBANQ)	the volume of domestic credit provided to the private sector by commercial banks.	WDI
11	Government expenditure (DEPGOV, % annual growth)	They capture the final consumption expenditure of general government.	WDI
12	Degree of commercial openness (COM% of GDP)	Trade is the sum of exports and imports of goods and services, measured as a percentage of gross domestic product. Trade openness, while essential to economic development, exposes African countries to external shocks. Financial inclusion, by acting as a shock absorber and transformation lever, appears to be a necessary condition for this openness to become a factor of resilience rather than vulnerability. A coordinated policy between trade integration and financial deepening is therefore key to building sustainable resilience in Africa.	WDI
13	Vulnerable employment (EMPVUL)	vulnerable employment defined as the ratio of vulnerable jobs to the population. This variable is a proxy representation to the informal sector's share of the economy.	WDI

Source: by the author from the World Bank Database 2023.

4. Empirical Analysis

The analysis here is based on four independent dynamic panel models. The first model measures the impact of control variables on the performance of sub-Saharan African economies. The second model analyzes the impact of conventional financial inclusion variables on the economic growth in sub-Saharan African countries. The third model focuses on the impact of access to digital financial services on the economic resilience of sub-Saharan African countries. Finally, the fourth model simultaneously measures the influence of both traditional and digital financial inclusion on economic resilience in sub-Saharan Africa. Consequently, the econometric estimation is therefore structured around four main results: presentation of descriptive statistics for the data used in this study, analysis of correlations between the independent variables, dynamic panel results with GMM estimator and robustness analysis.

4.1. Descriptive Statistics

Table 2 below presents the descriptive statistics of the variables used in our model. The aim here is to evaluate the average proportion and the symmetrical or asymmetrical evolution of the variables selected for the countries in the sample.

Table 2. Descriptive statistics.

Variable	Obs	Average	Standard deviation	Min	Max
PIB	56	1.97	2.71	−8.72	11.37
CRTE	56	10.03	10.14	7.32	13.15
DEBCRTE	56	14.06	13.95	11.37	15.73
DEPBAQ	56	14.12	14.12	12.09	16.51
ATM	56	6.56	6.45	4.31	8.08
ARGMOB	56	16.97	15.11	6.79	30.05
TMOBIL	56	21.69	25.10	8.05	29.01
INFL	56	22.524	3.99	−2.43	557.20
CREDBANQ	56	22.86	16.70	5.23	64.35
COM	56	64.70	61.68	33.73	112.90
DEPGOV	56	3.85	2.615	−55.34	142.10
EMPVUL	56	61.39	68.14	21.07	92.31

We first observed that the growth rate of wealth produced on average by sub-Saharan African countries is estimated at 1.97%. Regarding the explanatory variables, we found that, for a set of 1000 banked individuals, the average use of credit and debit cards are estimated at 10.03% and 14.06% respectively. This result, con-

trary to that of Nizamani et al. (2017), suggested the crucial lack of credit provision in this African region. We also noted in this table that for 1000 individuals living in sub-Saharan Africa, the average use of ATMs is approximately 6.56%. In addition, for every 1000 people which a bank account, an average of 14.12% make deposits with commercial banks. As for access to digital financial services, an average of 16.97% of every 1000 people in sub-Saharan Africa have a Mobile Money account.

Among the latter, an average of 21.69% of individuals constantly carry out financial transactions through their mobile accounts. These descriptive statistics gave an empirical perception of the nature of the data used. When we looked at the standard deviations of all the variables, as well as the difference between their maximum and minimum values, we saw that there is considerable dispersion in the data. **Table 2** showed that the number of Mobile Money transactions varies between 08 and 29 (standard deviation of 25.10). In addition, individuals in the region had a minimum of 07 and a maximum of 30 Mobile Money accounts (standard deviation of 15.11. Individuals living in urban areas enjoyed privileges than rural populations in terms of access to financial services. Information asymmetry and the lack of financial infrastructure in this African region contributed to reducing credit accessibility and accentuating social disparities between rural and urban areas (Matekenya et al., 2021).

4.2. Correlation Matrix

To test for the presence of multicollinearity among the regressors that could affect the reliability of the results, the correlation matrix is used to check pairwise correlations between variables. To this end, using a general benchmark of 0.7 as the cut-off point, the results presented in **Table 3** below highlight the low presence of multicollinearity among the variables identified. In fact, the results show that there are not enough high correlations between all the variables, except for a few, two of which are significant and deserve to be justified. On the one hand, we observe a high correlation between the number of debit cards and the number of ATMs, estimated at 77.81%.

This statistical result means that these two financial inclusion variables are used for similar purposes. In fact, bank lending is very limited in sub-Saharan Africa. This is why the use of debit cards by African nationals is equated with their use of ATMs. On the other hand, we also find that the number of mobile money accounts and mobile money transactions are strongly correlated at 76.5%. The other strong correlations observed concern credit cards, the volume of credit from the monetary sector to the private sector, the number of bank depositors and mobile money transactions. We also note that trade openness and the volume of credit from the monetary sector to the private sector are strongly correlated at 60.28%. This statistical result reflects the idea that bank credit is the instrument used by the private sector to finance import of goods and services. As a result, most African households use a proportion of their bank deposits, either as serving or emergency funds, to carry out goods and services import activities.

Table 3. Correlation matrix.

Variable	PIB	CRTE	DEBCRTE	DEPBAQ	ATM	ARGMOB	TMOBIL	INFL	CREDBANQ	COM	DEPGOV	EMPVUL
PIB	1											
CRTE	−0.25	1										
DEBCRTE	−0.09	−0.18	1									
DEPBAQ	0.21**	−0.12	0.48***	1								
ATM	−0.14	0.06	**0.77*** **	0.30***	1							
ARGMOB	0.33	−0.20	0.23*	**0.66*** **	−0.09	1						
TMOBIL	0.37***	−0.15	0.09	**0.50*** **	−0.18	**0.76*** **	1					
INFL	−0.33***	−0.088	0.35***	0.10	−0.03	0.22*	0.15	1				
CREDBANQ	−0.06	**0.68*** **	−0.40***	−0.20	−0.06	−0.24*	−0.01	−0.24*	1			
COM	−0.08	0.36***	−0.24*	−0.08	−0.08	−0.31**	−0.26*	−0.12	**0.60*** **	1		
DEPGOV	0.33***	−0.04	0.15	0.23*	−0.01	0.29**	0.31**	−0.09	−0.03	−0.07	1	
EMPVUL	−0.01	−0.57***	0.20	0.06	0.04	0.07	−0.24*	0.08	−0.84***	−0.61***	−0.05	1

Source: by the author based on World Bank data 2023. *P < 10%; **P < 5%; ***P < 1%.

4.3. GMM Estimation Results

The results in Table 4 below help to assess the impact of traditional and digital financial inclusion variables on the resilience of sub-Saharan African economies.

Table 4. Results of GMM estimation on dynamic panel data.

Variables	Model 1	Model 2	Model 3	Model 4
GDP growth (−1)	***−0.68	***−1.07	***−0.78	****−1.01
Credit card (CRTE)		−5.23E−06		−4.24E−06
Debit card (DEBCRTE)		−3.42E−06		−2.96E−06
Bank depositors (DEPBAQ)		1.76E−08		5.35E−08
ATMs (ATM)		−0.00		−0.00
Active mobile money accounts (ARGMOB)			−0.56	−0.10
Mobile money transactions (TMOBIL)			0.29***	−0.07
Inflation rate (INFL en % annuel)	***−0.052	***−0.05	***−0.05	***−0.05
Volume of bank credits (CREDBANQ)	***−0.85	***−1.46	***−0.84	***−1.22
Degree of trade openness (COM% of GDP)	0.13***	0.12**	0.13***	0.14**

Continued

Government expenditure (DEPGOV, % annual growth)	***−0.04	*−0.06	***−0.06	−0.05
Vulnerable employment (EMPVUL)	1.18***	1.25**	**1.25	1.41*
Comments	100	96	100	96
Sargan test	0.26	0.14	0.12	0.08
AR autocorrelation test (2)	0.87	0.76	0.71	0.92

Source: by the author based on World Bank data 2023. *P < 10%; **P < 5%; ***P < 1%.

To ensure the consistency of the GMM estimators and the robustness of our models, we performed autocorrelation and instruments validity tests. For reference, in Model 1, the probabilities of the Sargan tests (0.26) and the second-order autocorrelation tests are greater than 0.05. This means that the dependent variable "GDP", representing the economic resilience of the economies in the sample, is well explained by the independent variables used in our model. The results of our GMM estimation shown in Table 4 above, lead to the following analyzes and interpretations:

1) Model 1 assesses the effect of control variables, and model 4, measures the influence of both traditional and digital financial inclusion in sub-Saharan Africa economies. We find that the inflation rate and the volume of domestic credit provided by the private sector by commercial banks exert a negative and significant influence on the 1% threshold on the economic resilience of countries in the region.

The rising levels domestic credit generally translate into improved levels of access to financial services for both households and businesses; particularly small and medium-sized enterprises, for whom access to finance remains a significant barrier to growth (Kidanemariam & Makina, 2015). However, these growing levels of domestic credit need to be assessed not only in relation to their absolute levels, but also in relation to credit utilization and its impact on the structural transformation of economies in Ghana, Kenya, Nigeria, and Zambia[11]. In some African countries, the funds available for lending are not fully utilized, or are channelled into sectors that have a suboptimal impact on the structural transformation of economies. Many banks in the region remain risk-averse and hold high levels of securities that can be realized in the very short term. This translates liquidity ratios well above regulatory thresholds—such as government securities, or limits lending to select low-risk borrowers, notably very large corporates. This reduces lending, particularly to the small and medium-sized enterprise sector. The results of model 1 therefore reveal a positive and significant contribution to the 10% threshold of trade openness and informal sector activities to the resilience of sub-Saharan African economies. This means that when foreign trade and the informal economy increase by 1% in the region, economic resilience increases by

[11]Ghana, Kenya, Nigeria and Zambia.

0.13% and 1.18% respectively. Results highlighting the significant contribution of trade openness and informal sector activities in strengthening the resilience of sub-Saharan African economies.

2) Model 2 evaluates the impact of traditional financial inclusion variables on economic resilience in sub-Saharan Africa. We find that credit and debit card usage are low and insignificant. The same is true of the negative impact of ATMs on the economic growth in the region's countries.

In sub-Saharan Africa, access to traditional financial services is particularly limited, due to the low density of financial infrastructure, with fewer than seven ATMs per 100,000 inhabitants[12]. Access remains particularly limited in rural areas due to the concentration of bank branches in urban centers (Guérineau & Jacolin, 2014). The proportion of the population having opened an account or who has taken out a loan with a financial institution also remains very low. Using bank account remains limited, as the preference liquid currency is very strong and cashless payments are rare. Bank accounts are mainly used to secure the payment of salaries, taxes, or migrant transfers, and to reduce the risk of theft. However, informal credit from personal networks remains the main mode of financing for most of the community's population. These informal credit venues mainly finance short-term needs and, to a lesser extent, property investments and, only marginally, lead to productive investment. This explains the insignificance and low use of credit and debit cards observed in the region's economies.

3) In model 3, we find that mobile financial transactions have a positive and significant impact at 1% level on the economic resilience of sub-Saharan African countries.

Financial technologies positively influence economic resilience not only through the high level of financial literacy, but also through investment in financial services (Ndubuisi et al., 2021). The high costs of financial transactions and the failure of financial infrastructure encourage Africans to prefer digital payments to carry out their transactions. Considering the Covid19 pandemic context, the results of Chaintreau and Mvondo (2021) reported that digital financial technologies, more specifically Mobile Money, have helped to alleviate the effects of the health crisis through a process of digital identification of businesses and households from the informal sector. And this has the aim to stimulate economic growth in the short term and strengthen the resilience of economies (Miller et al., 2020). GDP, total factor productivity and investment have been identified as the channels through which financial technologies contribute to strengthening the resilience of African economies (Mora-Rivera & García-Mora, 2021).

4.4. Robustness Analyzes

The robustness tests carried out here consist in identifying the stability of our results by considering other indicators for measuring economic resilience in sub-Saharan Africa. With reference to the work of Jiang et al. (2021), we use the GDP

[12]Regional economic outlook, 2022.

per capita to assess the resilience of African nationals (Table 5), and the informal sector to analyze its contribution to economic resilience (Table 6).

Table 5 and Table 6 present the results obtained by considering two other proxy indicators of economic resilience in sub-Saharan Africa. In the dynamic panel GMM specifications, the probabilities of the Sargan tests and the second-order autocorrelation tests are greater than 0.05. This means that the dependent variables "GDP per capita" and "Vulnerable employment", representing a proxy for economic resilience in sub-Saharan Africa, have a very high probability of occurrence. We thus reach the same conclusions as in Table 4, where we observed a significant impact of traditional and digital financial inclusion on the resilience of the economies identified. However, the statistical significance observed for the informal sector reflects its importance in the structural transformation of sub-Saharan African economies. Additionally, digital determinants such as mobile money have a positive and more significant effect on economic resilience if used more to finance income-generating activities from the informal sector. However, both access to traditional financial services and digital factors financial inclusion have their shortcomings, although they both contribute to the resilience of the region's economies, hence their complementarity on each other.

Table 5. Resilience of sub-Saharan Africans.

Variables	Model 1	Model 2
GDP growth (−1)	***−0.60	***−0.80
Credit card (CRTE)		−4.45E−06
Debit card (DEBCRTE)		−2.85E−06
Bank depositors (DEPBAQ)		5.85E−08
ATMs (ATM)		**−0.00
Active mobile money accounts (ARGMOB)		
Mobile money transactions (TMOBIL)		
Inflation rate (INFL en % annuel)	***−0.04	***−0.05
Volume of bank credits (CREDBANQ)	−0.29	**−0.80
Degree of trade openness (COM% of GDP)	0.05	0.11*
Government expenditure (DEPGOV, % annual growth)	*−0.03	−0.04
Vulnerable employment (EMPVUL)	1.27**	1.31***
Comments	100	100
Sargan test	0.71	0.14
AR autocorrelation test (2)	0.94	0.76

Source: by the author based on World Bank data 2023. *P < 10%; **P < 5%; ***P < 1%.

Table 6. Impact of financial inclusion variables on the informal sector.

Variables	Model 1	Model 2	Model 3
Vulnerable employment: EMPVUL (−1)	**0.87*** **	**0.89*** **	**0.68*** **
Credit card (CRTE)		**−7.53E−07*** **	
Debit card (DEBCRTE)		−1.34E−07	
Bank depositors (DEPBAQ)		**−1.11E−08*** **	
ATMs (ATM)		5.47E−06	
Active mobile money accounts (ARGMOB)			**−0.11** *
Mobile money transactions (TMOBIL)			−0.02
Inflation rate (INFL en % annuel)	**0.00*** **	0.00	0.00
Volume of bank credits (CREDBANQ)	**−0.05*** **	**−0.06*** **	**−0.04** *
Degree of trade openness (COM% of GDP)	**−0.00*** **	**−0.02*** **	**−0.01*** **
Government expenditure (DEPGOV, % annual growth)	**0.00*** **	0.00	**0.00*** **
Comments	100	100	100
Sargan test	0.35	0.32	0.2
AR autocorrelation test (2)	0.35	0.65	0.83

Source: by the author based on World Bank data 2023. *$P < 10\%$; **$P < 5\%$; ***$P < 1\%$.

5. Conclusion and Policy Implications

Financial inclusion remains an important issue for the development of low-income countries' economies. This study investigates the contribution of characteristics linked to both traditional and digital determinants that contribute to financial inclusion and economic resilience in sub-Saharan Africa. The results highlight positive and significant impact of digital determinants on financial inclusion and economic resilience. The findings indicate that digital determinant characterized by the number of mobile money transactions has a positive and significant effect on the resilience of these countries' economies. Equally, domestic credit volume and inflation that are among traditional factors are found to be negatively associated with economic resilience. Furthermore, methods of payment such as credit and debit cards hardly stimulate the economic performance of the economies identified in times of crisis.

This study in addition to contributing to the literature on financial inclusion and economic resilience has practical implications for practice. It enhances our knowledge of how the digitization of financial information affects financial inclusion and economic resilience of sub-Saharan African countries. It also provides a holistic view of the benefit of digital determinants benefits and their contribution to financial inclusion. To reinforce this influence, sub-Sahara countries might fi-

nancial education and encourage the banking system to consider activities from the informal sector for greater financial inclusion. Additionally, solutions related to the development of the financial sector and financial products to encourage risk pooling and investments can help strengthen financial inclusion. This would lead to a gradual reallocation of credit to households and businesses towards productive investment as it will take in consideration specific economic constraints of households and businesses operating in this specific environment. These actions will enable nationals of sub-Saharan Africa to develop their business and accumulate assets in addition to contributing to rising household consumption, which strengthen their economic resilience. Overall, the results of this study should be of interest to regulators in sub-Sahara countries for policy orientation that seek to strengthen financial inclusion and economic resilience.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendices

Table A1. List of sub-Saharan African countries.

N°	COUNTRY	REGIONS	INCOME LEVEL
1	Angola	Central Africa	Lower Middle Income
2	South Africa	Southern Africa	Higher Income
3	Benign	West Africa	Upper Middle Income
4	Botswana	Southern Africa	Upper Middle Income
5	Burkina Faso	West Africa	Lower Income
6	Cameroon	Central Africa	Average income
7	Congo Brazzaville	Central Africa	Average income
8	Ivory Coast	West Africa	Upper Middle Income
9	Ethiopia	East Africa	Average income
10	Gabon	Central Africa	Upper Middle Income
11	Ghana	West Africa	Upper Middle Income
12	Guinea	West Africa	Lower Middle Income
13	Equatorial Guinea	Central Africa	Upper Middle Income
14	Kenya	East Africa	Higher Income
15	Mozambique	East Africa	Lower Income
16	Namibia	Southern Africa	Higher Income
17	Nigeria	West Africa	Higher Income
18	Democratic Republic of Congo	Central Africa	Upper Middle Income
19	Rwanda	East Africa	Lower Middle Income
20	Senegal	West Africa	Higher Income
21	Tanzania	East Africa	Upper Middle Income
22	Chad	Central Africa	Lower Middle Income
23	Zimbabwe	Southern Africa	Lower Middle Income

Source: Author based on data from the African Development Bank 2022.