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ACCESS TO FINANCE IN THE DIGITAL AGE: DOES DIGITAL FINANCIAL INCLUSION PROMOTE FINANCIAL DEVELOPMENT IN EMERGING COUNTRIES?

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Armand Fréjuis Akpa
Institut Supérieur Agronomique et Vétérinaire de Faranah (ISAV/F), Faranah, Guinée
Email: frejuisakpa@gmail.com

Mingnimon Ghislain Gnidehou
Laboratoire d'Economie Publique (LEP), Faculté des Sciences Economiques et de Gestion, Université d'Abomey-Calavi (UAC), Abomey-Calavi, Benin
Email: gnidehoughislain@gmail.com

Corresponding author: **Armand Fréjuis Akpa**

Abstract

This study's purpose is to assess the influence of digital financial inclusion (DFI) on financial development in sub-Saharan African (SSA). Using a sample of 26 SSA nations over the period from 2014-2021 and the general method of moments in system (SGMM) on panel data, the estimation results show that both digital access and digital use promote financial development. Similarly, DFI improves financial development, allowing us to confirm that DFI is a key factor that promotes financial development. The study suggests that cybersecurity needs to be strengthened to secure online platforms and that incentive policies and regulatory measures favourable for the development of human capital capable of operating in this sector need to be put in place.

Keywords: Digital financial inclusion, financial development, access to finance

JEL Codes: G20 – O16 – O30

1. Introduction

Financial development (FD), which involves declining fees incurred in the financial system (Ehigiamusoe et al., 2021; El Menyari, 2019), has been largely debated. Indeed, for Levine (2005), FD occurs when financial instruments, markets, and intermediaries reduce the impact of information asymmetry, enforcement challenges, and transaction costs, thereby improving financial service efficiency and quality. Thus, FD remain broadly identified, describe economic growth, and establish occupational occasions (Easterly & Levine, 2001; Zaidi et al., 2019). The seminal works of Schumpter (1930) recognized the financial sector as a priority for economic development through investment in innovation. However, access to finance in developing countries is limited by several factors, such as information imperfection (Stiglitz & Weiss, 1981). With the information and communication technologies (ICT) rapid development, several services, including financial services, have been digitalized and remain a way to accelerate financial development in emerging nations (Edo et al., 2021). Financial services digitalization constitutes a new concept called digital financial inclusion (Chinoda & Kapingura, 2023; Ozili, 2018).

In recent decades, DFI has attracted much interest (Ahmad et al., 2021; Chinoda & Kapingura, 2023; Ozili, 2018) because it is seen as a way to make radical advancements in the worldwide financial sector. DFI is a fraction of people and companies that access and use financial services via digital platforms (Elouaourti & Ibourk, 2024; Zhang et al., 2019). Digitalization has transmuted financial systems in emerging and advanced nations (Chinoda & Kapingura, 2023; Wysokińska, 2021). Obstacles in old-style financial systems continue to drop (Kooli et al., 2022), indicating a growth in financial inclusion, which is accepted as an important facilitator for reaching the 2030 Sustainable Development Goals (Allen et al., 2016). Nations with greater DFI levels are most capable of enduring economic growth challenges (Khera et al., 2021; Shen et al., 2021). Therefore, increasing the DFI can help individuals as well as firms to apply for loans online without leaving their houses or enterprises, which can improve their economic activities and, in turn, economic growth.

Earlier studies have linked DFI with other variables. Chinoda & Kapingura (2023) reported that institutional quality and governance improve the DFI-economic growth relationship in SSA. Ahmad et al. (2021) concluded in China that DFI improves economic growth. Ozturk & Ullah (2022) reported that economic growth and environmental sustainability are improved by DFI. However, the DFI's effect on financial development is under-consideration in the extant literature, although Manasseh et al. (2023) reported that DFI increases financial development in COMESA. This method is different from that of Manasseh et al. (2023) because it built a DFI index via principal component analysis. This paper's main purpose is to investigate the DFI and financial development nexus in SSA while addressing the gap which exists in the literature about this nexus. DFI can enhance financial development by providing financial services and digital access, specifically to monetarily underserved groups of individuals at feeble fees (Zhang et al., 2019) and offering digital paths of capital formation, savings, and investment occasions for jobs (Ozili, 2018).

The choice of SSA is since digital financial services use remains low; this constitutes a brake for financial development. Indeed, the percentage of the population aged 15 years and above who used a debit card increased from 9% in 2014 to 11% in 2021, while the percentage of those who used a mobile phone or the internet to pay bills increased from 6% in 2017 to 17% in 2021% (Global Findex, 2022). This feeble use of digital financial services is due to the low rate of internet penetration in SSA (35.86% in 2021) and to its high cost (Akpa et al., 2024a). Another reason is that only 23.841% of GDP domestic credit is provided to the private sector by banks over the period of 2014-2021 (World Bank, 2024). This shows the presence of credit constraints in the economy (Akpa et al., 2024b).

The rest of the paper is organized as follows. In addition to this introduction, the second section reviews the literature on the role of digitalization in the financial inclusion process on the one hand and DFI in the economy on the other hand. The analysis methods and data sources are presented in the third section, the results and discussion are presented in the fourth section, and section five concludes and presents policy implications.

2. Literature review

2.1. The role of digitalization in the financial inclusion process

DFI plays a crucial role in enhancing access to financial services, particularly in developing economies where ICT has eased the widespread mobile banking services adoption (Edo et al., 2021; Elouaourti & Ibourk, 2024). According to the World Bank (2024), internet and mobile phone penetration reached 35.86% of the population and 84.22 per 100 people, respectively, in 2021. This has led to an increase in approximately 55.07% of individuals holding an account with a financial institution or mobile money service provider. Consequently, digital financial services use has also increased (Global Findex, 2022). The debit or credit card ownership rate increased from 18% in 2014 to 19% in 2017. Similarly, the usage rate of debit and credit cards decreased from 9% in 2014 to 7% in 2021. In 2017, 31% of individuals with an account at a financial institution used mobile phones or the internet to check their account balance. Between 2014 and 2017, the percentage of individuals making or receiving digital payments rose from 28% to 34%, respectively. In 2017, approximately 6% of individuals used mobile phones or the internet to pay bills. Finally, by 2021, 25% of individuals owned a debit or credit card, 12% used a credit or debit card, 47% of individuals with an account at a financial institution used mobile phones or the internet to check their account balance, 50% engaged in making or receiving digital payments, and 17% utilized mobile phones or the internet to pay bills (Global Findex, 2022). These statistics reveal significant changes between 2017 and 2021, largely attributed to the COVID-19 pandemic, which, by imposing restrictions, led to increased usage of services through digital and mobile platforms.

Several studies across both developed and developing countries have concluded that ICT plays a key role in promoting financial inclusion. Bansal (2014) investigated the role of ICT in enhancing financial inclusion in rural India and reported that mobile banking services and ATMs help advance financial inclusion. Moreover, Kanungo and Gupta (2021), using data from Fitch Connect and a binary logistic model, concluded that digitalization had an insignificant effect on financial inclusion. Various studies in China have shown that financial digitalization accelerates access to financial services and improves financial inclusion. For example, Yue et al. (2022), using a fixed-effects model, proved that digital finance enhances household financial inclusion, while Rauniyar et al. (2021) highlighted that education levels strengthen the connection between digital services and financial inclusion.

However, some studies focus specifically on developing countries. Ozili (2018) proved, through fintech providers, that digital finance improves financial inclusion in both emerging and advanced economies. Similarly, Kshetri (2021) also employs exploratory analysis, revealing that digital technologies such as fintech and machine learning can be used to increase financial inclusion. Sodokin et al. (2022) confirm the findings of Ozili (2018) and Kshetri (2021), asserting that the digitalization of financial services improves both the performance of banks and financial inclusion in developing countries.

Several recent studies in SSA have analysed the role of digitalization in promoting financial inclusion. Akpa et al. (2024a) showed that the internet can be effectively complemented by good governance to improve financial inclusion. Senou et al. (2019) reported similar results for the West African Economic and Monetary Union (WAEMU), showing that the use of mobile phones and the internet contributes to strengthening financial inclusion. In South Africa, Mhlanga (2020), based on a conceptual analysis, reported that artificial intelligence (AI) improves digital financial inclusion, particularly in areas such as risk detection, measurement and management; addressing information asymmetry; providing customer support through chatbots; and enhancing fraud detection and cybersecurity. Olaoye et al. (2024) shows that digitalization enhances financial inclusion, measured by loans access while decreases the number of physical bank branches. The results imply that strategies focused on expanding financial inclusion by building traditional bank branches may have limited effectiveness, particularly in Africa, where a significant portion of the population remains outside the formal banking system.

2.2. Digital financial inclusion in the economy

Before the 2000s, research focused primarily on ways to improve financial inclusion and assist financially excluded individuals (Demirguc-Kunt et al., 2017; Kim et al., 2018). However, over the past decade, this debate has shifted beyond the question of financial inclusion, as the advent of digital financial services has led researchers to concentrate more on their impact on economic growth and development (Ahmad et al., 2021; Chinoda & Kapingura, 2023; Khan et al., 2023). Digital financial inclusion remains a key driver for establishing an inclusive society and economic system (Lenka & Barik, 2018). Notably, few studies have explored the link between the DFI and financial development. Instead, its effect has been primarily examined in relation to (i) economic growth (Chinoda & Kapingura, 2023; Khera et al., 2021; Shen et al., 2020), (ii) carbon emissions (Ozturk & Ullah, 2022; Wang et al., 2022), and (iii) income inequality (Soro & Senou, 2023; Suhrab et al., 2024).

With respect to economic growth, Ahmad et al. (2021) used a fixed-effects model to reveal that DFI improves economic growth in Chinese provinces. Similarly, Shen et al. (2020), applying spatial techniques to 86 neighboring countries, reported that DFI improves economic growth, with spillover effects on neighboring countries. These findings were confirmed by Shen et al. (2021) via the same spatial techniques. Khera et al. (2021) reached similar conclusions, emphasizing that the adoption of digital financial services has been a key driver of economic growth, with substantial variations across countries and regions, with the most significant progress observed in Africa, Asia, and OECD countries (Myovella et al., 2020). However, Chinoda & Kapingura (2023) concluded that institutional quality has a positive and significant effect on the link between DFI and economic growth in SSA.

Since then, several studies have analysed the influence of DFI on carbon emissions. Yu et al. (2022) and Yang et al. (2022) have shown an inverse link between DFI and carbon emissions, indicating that DFI reduces carbon emissions. However, other studies have reported controversial outcomes, with studies showing positive effects, whereas others have reported a U-shaped effect of DFI on carbon emissions (Lee et al., 2022; Wang et al., 2022). Khan et al. (2023) reported that in 76 emerging markets and economies, DFI increases carbon emissions. Ozturk & Ullah (2022) reported that DFI improves economic growth but worsens environmental quality. Soro and Senou (2023) discovered that in WAEMU countries, DFI worsens income inequality while Suhrab et al. (2024) showed that DFI decreases income inequality, with technological innovation and infrastructure development enhancing this effect.

Finally, regarding DFI's influence on financial development, to the authors' knowledge, only one study has examined this link. Manasseh et al. (2023) reported in the Common Market for Eastern and Southern Africa (COMESA) using a dynamic autoregressive distributed lag (ARDL) that the DFI promotes financial development. Given the literature review provided, the association between digital financial inclusion and financial development remains underexplored. As previously mentioned, digital service use eases financial inclusion. Furthermore, there has been rapid growth in the adoption of digital services in SSA over the past decade. This study thus contributes to the literature by addressing a gap in the association between DFI and financial development.

3. Methodology

3.1. Conceptual framework

DFI denotes the accessibility and provision of financial services via digital means, aiming to enable individuals and communities, especially those historically marginalized or excluded, to engage with the formal financial sector (Al Khub et al., 2024; Sun, 2018). It encompasses the use of digital platforms such as mobile banking, electronic payments, and other technological advancements to offer various financial services, including savings, loans, insurance, and transactions (Al Khub et al., 2024; Ozili, 2018). Its principal goal is to close the disparity between unbanked or underbanked populations and mainstream financial services, thereby fostering economic empowerment, reducing financial disparities, and advancing overall financial wellness by integrating technology into financial frameworks. DFI yields advantages such as enhanced integrity and security of the financial system, although it also presents risks for both consumers and providers (Al Khub et al., 2024; Sun, 2018).

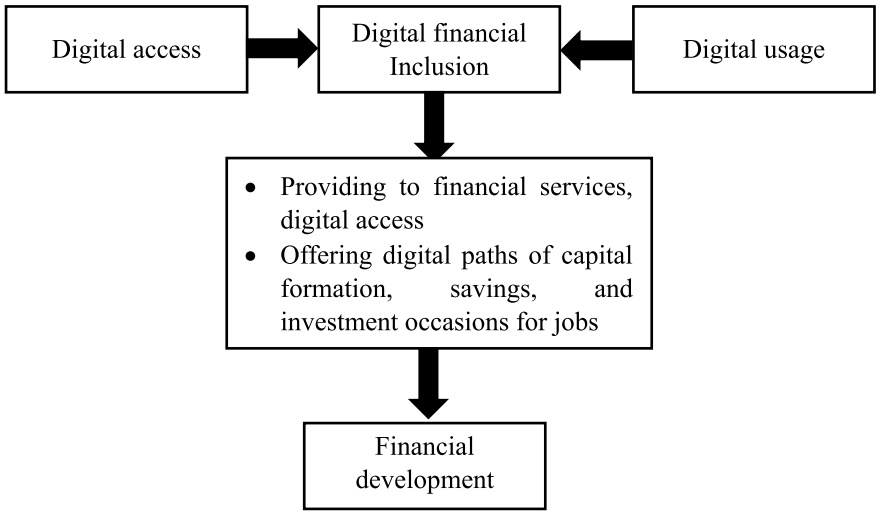

Figure: Relationship between digital financial inclusion and financial development
Source: Authors' compilation

In the above figure, we conceptualize the mechanism through which DFI enhances financial development in SSA. Access to financial services is very important for financing economic activities. However, in developing countries, people's access to financial services is limited. Only 23.841% of GDP domestic credit is provided to the private sector by banks from 2014-2021 (World Bank, 2024), showing the presence of credit constraints in the economy (Akpa et al., 2024b). Therefore, the rapid development of ICT has led to improvements in financial inclusion. Additionally, internet access improvement eases financial service access via webs. Thus, with digital access and the use of financial services, governments and policymakers can solve the transaction cost problem by reducing the distance between financial institutions and customers. Customers can also apply for loans via digital platforms made available by financial institutions that are still underdeveloped in SSA. The DFI concept encompasses two key components: digital access, quantified by a population proportion with internet access and mobile subscriptions per 100 individuals, and digital usage, gauged by the density of registered mobile money agents per 100,000 adults and the prevalence of active mobile money accounts per 1000 adults. Indeed, DFI enhances financial development by providing financial services and digital access, specifically to monetarily underserved groups of individuals at feeble fees (Zhang et al., 2019) and offering digital paths of capital formation, savings, and investment occasions for jobs (Ozili, 2018).

3.2. Construction of the DFI

Following Khera et al. (2021) and Chinoda & Kapingura (2023), the DFI index, which differs from the traditional financial inclusion index (Akpa et al., 2024a,c; Sarma, 2008), is built. For Chinoda

& Kapingura (2023), the indices used included access, penetration and usage dimensions, which are obtained from the World Bank Development Indicators. Overall, as required by the upgraded G20 Financial Inclusion Indicator System, this paper uses four indicators, namely, (i) the internet users' percentage, (ii) the number of mobile subscriptions per 100 people, (iii) the number of registered mobile money agents per 100,000 adults and (iv) the number of active mobile money accounts per 1 000 adults, to compute the DFI.

In DFI index construction, the PCA technique is applied to keep all variations accessible in the data, decrease data dimensionality, and solve potential multicollinearity that can occur (Chinoda & Kapingura, 2023; Nizam et al., 2020). Additionally, two subindices, access and usage, are computed via the PCA technique. Digital access regroups (i) percentage of internet users, (ii) mobile subscription per 100 people while digital usage regroups (iii) the number of registered mobile money agents per 100,000 adults and (iv) the number of active mobile money accounts per 1,000 adults.

Table 1 shows that approximately 86.2% of the information kept in the first principal component originates from the two indicators utilized to measure digital access. In simpler terms, this implies that approximately 86.2% of individuals owned a mobile phone and had access to the internet. Notably, the decision to keep the first principal component (PC) is guided by the Kaiser 1 criterion, which suggests that the eigenvalue should surpass one (Tchamyou, 2020). This aligns with the choice of digital access indicators in Table 1, as the corresponding first principal component has an eigenvalue of 1.723. Conversely, the eigenvalue for the second principal component stands at 0.277, failing to meet the Kaiser 1 criterion employed for retaining principal components.

Furthermore, the same information criteria used to retain the first principal component for digital access in Table 1 are also applied in Tables 2 and 3 for digital usage and digital financial inclusion, respectively.

Table 1. Principal component analysis (PCA) for digital access (DA)

Principal components	Component matrix (loadings)		Proportion	Cumulative proportion	Eigen value
	Internet	Mobile cellular			
First PC	0.707	0.707	0.862	0.862	1.723
Second PC	0.707	-0.707	0.138	1.000	0.277

Source: Authors' computation

Table 2. Principal component analysis (PCA) for digital usage (DU)

Principal components	Component matrix (loadings)		Proportion	Cumulative proportion	Eigen value
	MMA	AMMA			
First PC	0.707	0.707	0.799	0.799	1.597
Second PC	0.707	-0.707	0.201	1.000	0.403

Source: Authors' computation. MMA: mobile money agent and AMMA: active mobile money accounts

Table 3. Principal component analysis (PCA) for digital financial inclusion (DFI)

Principal components	Component matrix (loadings)		Proportion	Cumulative proportion	Eigen value
	DU	DA			
First PC	0.707	0.707	0.699	0.699	1.398
Second PC	0.707	-0.707	0.301	1.000	0.601

Source: Authors' computation

Following Khera et al. (2021), to obtain an index score between 0 (lowest) and 1 (highest), we applied normalization via the following formula via a global min–max technique across all nations and years:

$$x_{normalised} = \frac{x - x_{\min}}{x_{\max} - x_{\min}}$$

3.3. Dynamic panel data modelling approach

Several studies in the literature analyse the macroeconomic determinants of financial development. However, the particularity of this paper is that DFI is inserted as a financial development driver. To estimate equation (1), the ordinary least squares (OLS) technique can be applied (Cameron & Trivedi, 2010), but estimating equation (1) without considering financial development persistence can lead to biased results. Indeed, the correlation between FD and its lag value is equal to 0.9944 (Table 4). Instead, dynamic panel data models are applied to explore the DFI and financial development nexus. Unlike the OLS model, which does not yield efficient estimates, the GMM method provides solutions to similarity bias issues, reverse causality, and omitted variables (Akpa et al., 2024a,b). Thus, the lagged value of financial development is incorporated into the model, as financial development may gradually vary over time; henceforth, financial development persistence is taken, which makes the model dynamic (Akpa et al., 2024a,b; Ibrahim & Sare, 2018; Kagochi, 2019). Owing to the existence of FD lagged in the equation, the Arellano & Bover (1995) GMM in the system estimator is employed because it is a strong panel data procedure to investigate the DFI-financial development nexus in SSA. Similarly, this paper uses the GMM technique because it is in finance and is extensively applied because of the presence of endogeneity in financial choices (Ahmad et al., 2021; Akpa et al., 2024a,b). Other arguments that led us to use the GMM are that (i) the individual dimension (N=26 countries) is superior to the time dimension (t=8 years), (ii) country variations are not eliminated with the estimation method, and (iii) the system GMM technique corrects biases in small samples that are inherent to the difference estimator (Akpa et al., 2024a,b; Tchamyou, 2020). Founded in overhead development, our research model is formulated as follows:

$$\mathrm{FD_{it}} = \mathrm{f(DFI_{it}, Z_{it})} \quad (1)$$

where FD_{it} denotes the financial development of country i in period t; DFI_{it} is digital financial inclusion; and Z_{it} is a vector of control variables.

The empirical model used to analyse the effect of the DFI on financial development is specified as follows:

$$\mathrm{FD_{it}} = \alpha_0 + \alpha_1 \mathrm{FD_{it-1}} + \alpha_2 \mathrm{DFI_{it}} + \sum_{i=2}^{n} \alpha_i \mathrm{Z_{it}} + \tau_t + \varepsilon_{it} \quad (2)$$

where $\mathrm{FD_{it-1}}$ is the lagged value of financial development, α_i are estimated parameters, and Z_{it} is a vector of variables that represents the control variables. τ_t represents the time effect, whereas ε_{it} represents the error terms with a normal distribution.

Table 4. Persistence of financial development variable

	Financial development	Lag Financial development
Financial development	1	
Lag Financial development	0.9944*** (0.000)	1

Source: Authors ***p<5%

3.4. Data and variable selection

This study used annual data from 26 SSA nations over the period from 2014-2021, which were extracted from several datasets, notably the International Monetary Fund (IMF), Financial Access Survey (FAS) and World Development Indicators (WDI). The dependent variable is financial development. The data are sourced from WDI and supported by Gu et al. (2021) and Khan et al. (2019). To compute the DFI index, four indicators are used; notably, the percentage of internet users and mobile subscriptions per 100 people who are taken from WDI, the number of registered mobile money agents per 100,000 adults and the number of active mobile money accounts per 1,000 adults are obtained from the IMF FAS. This variable choice is based on Chinoda & Kapingura (2023) and Ahmad et al. (2021), and the expected sign is positive, indicating that DFI improves financial development.

Economic growth per capita is provided by WDI and sourced from Senou et al. (2019), Liu et al. (2021) and Akpa et al. (2023). Trade openness is sourced from WDI and is supported by Chatterjee (2020) and Sikayena et al. (2022). The expected sign is positive, which shows that trade openness improves financial development. The inflation is sourced from the WDI, and the variable choice is supported by Ibrahim & Sare (2018) and Chinoda & Kapingura (2023). The expected sign is negative, meaning that inflation lessens financial development.

The variables used, as well as their definitions and expected signs, are summarized in Table 5.

Table 5. Description of the estimation variables

Variables	Measures	Sources	Sign
FD	Financial development, measured by domestic credit to private sector by banks (% of GDP)	WDI	
DA	Digital access, computed using PCA on internet and mobile cellular telephone	WDI	+
DU	Digital usage, computed using PCA on mobile money agents registered and mobile money active accounts	IMF/FAS	+
DFI	Digital financial inclusion, computed using PCA on internet, mobile cellular telephone, mobile money agents registered and mobile money active accounts	IMF/FAS/ WDI	+
GDPC	Economic growth per capita is measured by annual growth of gross domestic product per capita in %	WDI	+/-
INF	Inflation, measured by the Consumer Price Index in annual %	WDI	-
TRADE	Trade openness, measured by the sum of import and export goods divided by gross domestic product.	WDI	-

Source: Authors' computation

4. Results and discussion

Descriptive statistics show that financial development (% GDP) averages 23.841 in SSA (Table 6). With a minimum of 5.237 and a maximum of 128.838, this indicates a considerable gap and reflects heterogeneity among the sample nations. The average values of the subindices of DFI, i.e., digital access and usage, are 0.373 and 0.207, respectively. The DFI index has an average value of 0.317; the standard deviation value is low, which shows that the SSA is at approximately the same level in terms of the DFI. The average economic growth per capita is 0.728, with a standard deviation of 3.612. This shows a disparity in economic growth per capita among SSA. The average inflation is 12.675%, with a standard deviation of 51.985, indicating the heterogeneity of living costs among SSA countries. Trade openness has an average value of 0.518, with a standard deviation of 0.229, indicating a relatively homogenous distribution. Table 2 also reports the correlation outcomes among the variables. The outcomes indicate that digital access (0.611) and digital financial inclusion (0.294) are positively associated with financial development. Similarly, trade openness (0.143) is positively related to financial development. The findings also reveal that variables such as economic growth per capita (-0.083), inflation (-0.130) and digital usage (-0.031) are negatively related to financial development.

Table 6. Descriptive statistics

	Financial development [1]	Digital access [2]	Digital usage [3]	Digital financial inclusion [4]	Economic growth [5]	Inflation [6]	Trade openness [7]
Obs.	200	198	159	151	208	201	197
Mean	23.841	0.373	0.207	0.317	0.728	12.675	0.518
Std. dev.	22.694	0.220	0.172	0.190	3.612	51.985	0.229
Min	5.237	4.10e-08	6.07e-08	4.91.e-08	-12.889	-3.233	0.094
Max	128.838	1	1	1	9.562	557.201	1.237
Correlations							
[1]	1						
[2]	0.611	1					
[3]	-0.031	0.413	1				
[4]	0.294	0.840	0.840	1			
[5]	-0.083	-0.041	0.120	0.062	1		
[6]	-0.130	-0.016	0.029	-0.004	-0.303	1	
[7]	0.143	0.323	0.028	0.211	-0.129	-0.055	1

Source: Authors' computation

Table 7 reports the outcomes of the estimate of the DFI's effect on financial development via the SGMM technique. The diagnostic test results revealed that the model is globally significant because the Fisher test probability is less than 1%. Similarly, the results revealed the presence of first-order autocorrelation (AR (1)) and the absence of the AR (2) effect. This is in line with the hypotheses formulated. Moreover, the Sargan and Hansen tests confirm the instruments' choice for the three estimates. The lagged value coefficient of financial development is positive for all estimated specifications, revealing that financial development is a self-sustaining process. Indeed, past value of financial development improves its current value, indicating that the variables persist.

Table 7. Effect of DFI on financial development via SGMM

Variables	Dependent: Financial development		
	(1)	(2)	(3)
Financial development (-1)	0.903*** [0.029]	0.860*** [0.024]	0.818*** [0.027]
Digital access	5.117*		

	[2.772]		
Digital usage		6.047***	
		[1.356]	
Digital financial inclusion			9.433***
			[2.271]
Economic growth per capita	-0.190***	-0.283***	-0.292***
	[0.067]	[0.034]	[0.052]
Inflation	-0.005***	-0.025***	-0.029***
	[0.001]	[0.05]	[0.00 5]
Trade openness	-1.014	1.048	-0.542
	[0.733]	[0.898]	[0.993]
Constant	0.971	2.028**	2.221***
	[0.695]	[0.767]	[0.685]
Diagnostics			
Time effects	Yes	Yes	Yes
Fisher test (p value)	11302.40***	18768.72***	20130***
	(0.000)	(0.000)	(0.000)
AR(1) (p value)	-2.27**	-1.91*	-1.86*
	(0.023)	(0.056)	(0.063)
AR(2) (p value)	-0.20	-1.58	-1.16
	(0.841)	(0.114)	(0.245)
Sargan test (p value)	40.13	11.76***	13.84*
	(0.000)	(0.109)	(0.054)
Hansen test (p value)	8.33***	19.91***	11.19***
	(0.305)	(0.142)	(0.131)
Number of observations	156	131	126
Number of countries	26	24	24
Number of instruments	19	19	19

Source: Authors' computations (*p<10%, **p<5%, ***p<1%, values in [] and () are standard errors and p values, respectively).

Looking at the first two estimates, the two subindices of DFI, digital access and usage, improve financial development. The latest estimation results (column 3) revealed that the DFI also enhances financial development. One unit increase in digital access, digital use and digital financial inclusion improved financial development by 5,117, 6,047 and 9,433 units, respectively. The results imply that formal financial service access and use via digital platforms are beneficial for financial development because they reduce the distance between individuals and financial institutions and thus fall into barriers in traditional financial systems. This outcome conforms to that of Manasseh et al. (2023), who found in COMESA that digital financial innovation measured by automated teller machines (ATMs), points of sale (POSs), mobile payments (MPs) and mobile banking (MBs) enhances financial system development. Similarly, this outcome conforms to studies that reported that the DFI is beneficial for economic growth (Ahmad et al., 2021; Chinoda & Kapingura, 2023) and air quality (Yang et al., 2022; Yu et al., 2022). Thus, to improve financial development in SSA, financial services digitalization is needed to ease its access and usage.

The results also showed that control variables, notably economic growth per capita and inflation, are significant for the DFI subindices (digital access and usage) as soon as the DFI index is used. The estimated outcomes show that per capita income and inflation have a significantly negative influence on financial development. An increase of one unit in economic growth per capita reduces financial development by between 0.190 and 0.292. This result implies that the level of economic growth per capita achieved by SSA nations is not favourable for financial development. This result is consistent with that of Kagochi (2019), who showed that economic growth worsens financial development, as measured by private credit (PC), liquid liabilities (M), and bank assets (DM). The results also confirmed those of Alshubiri et al. (2019), who reported that GDP growth decreases financial development in Gulf Cooperation Council

countries. Kagochi (2019) explained his outcome as several SSA nations being characterized by low average economic growth per capita, which could not create better conditions for sound market-based financial structure formation. This is also the case in our sample, where the average economic growth per capita is 0.728 (Table 6).

Similarly, a one-unit increase in inflation lessens financial development by 0.005-0.029. This outcome shows that inflation is not conducive to financial development; therefore, an effective financial development policy is needed. However, Ibrahim et al. (2022), using inflation as an interaction variable between financial development and economic growth, reported that there is a threshold above which its effect becomes negative (6.76% and 7.65%). This finding shows that moderate inflation does not change the dynamics of financial development. The outcomes are related to Ibrahim & Sare (2018) and Kagochi (2019), who showed that inflation reduces financial development. For Kagochi (2019), a greater inflation rate will curb the credit distributed to the private sector. The author also suggested that inflation impedes increases in investment and productivity, both of which are produced by the private sector.

5. Conclusion

In emerging countries, the population has limited access to financial services because of their low rate of financial inclusion. The development of information technologies provides financial institutions with the possibility of financially including populations to finance systems through digital platforms, which is what we call digital financial inclusion. This paper's main goal is to explore the DFI's influence on financial development in SSA countries. Data are collected from 26 countries over the period of 2014-2021, and the GMM system technique is used to analyse the data. The outcomes showed that digital access and use promote financial development. Similarly, the DFI index is positively and significantly related to financial development, allowing us to confirm that the DFI is a factor that promotes financial development in SSA countries.

The findings suggest insightful policy implications not only for policymakers but also for governments to promote financial development in SSA. Thus, policies to strengthen cybersecurity need to be taken to secure online platforms. Indeed, as financial services are provided via digital platforms, secure online platforms also help to avoid hacking and financial crimes. SSA nations need to develop economic activities that could create better conditions for sound market-based financial structure formation to promote financial sector development. Some action needs to be taken to combat inflation by supporting domestic production to lower the consumer price index because a greater inflation rate will curb credit distributed to the private sector. The implementation of all these policies will help promote financial development.

This study is not without limitations that constitute room for future research. A good level of education is essential for people to understand the use of digital technologies via digital platforms. This study did not consider the role that education can play in the understanding of financial service use via digital platforms, which constitutes a limitation of our study. Therefore, in future studies, we can explore the role of education in the relationship between digital financial inclusion and financial development.

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