FINANCIAL INCLUSION THROUGH DIGITAL CHANNELS AND THE GROWTH-INEQUALITY-POVERTY TRIANGLE: EVIDENCE FROM AFRICA

By
Olawale I. Wale-Awe
Department of Finance, Babcock University, Ilishan, Ogun State, Nigeria.
Email: wale-aweo@babcock.edu.ng
Olaniyi Evans
School of Management & Social Sciences, Pan-Atlantic University, Lagos, Nigeria.
Email: oevans@pau.edu.ng

Abstract

This study investigates the causal relationship between digital financial inclusion (DFI) and the growth-inequality-poverty triangle in a panel of 42 African countries for the period 1995 to 2018. Simultaneous-equations models, the two-step system generalized method of moments (GMM) versus the default one-step approach, and Toda Yamamoto causality test are used to investigate this relationship. The main results provide evidence that digital financial inclusion has significant negative effects on poverty and inequality, but significant positive effects on growth of GDP per capita, implying that increase in DFI is associated with reduction in poverty and inequality, but increase in economic growth. The implication is that DFI can promote economic growth, as well as alleviate poverty and stem the tide of inequality. The empirical results further show that there is unidirectional causality flowing from DFI to growth and inequality while bi-directional causality exists between DFI and poverty. Interestingly, there is bi-directional causality between growth and inequality, growth, and poverty, as well as between inequality and poverty. Overall, the findings imply that improving digital access to financial services across the continent is essential to increasing income levels, alleviating poverty, and aiding more even distribution of income. Future studies can improve on the extant literature by exploring whether the established findings withstand empirical analysis within country-specific settings.

Keywords: digital financial inclusion; poverty; inequality; growth
JEL Classification: G21, G23, O16, C32

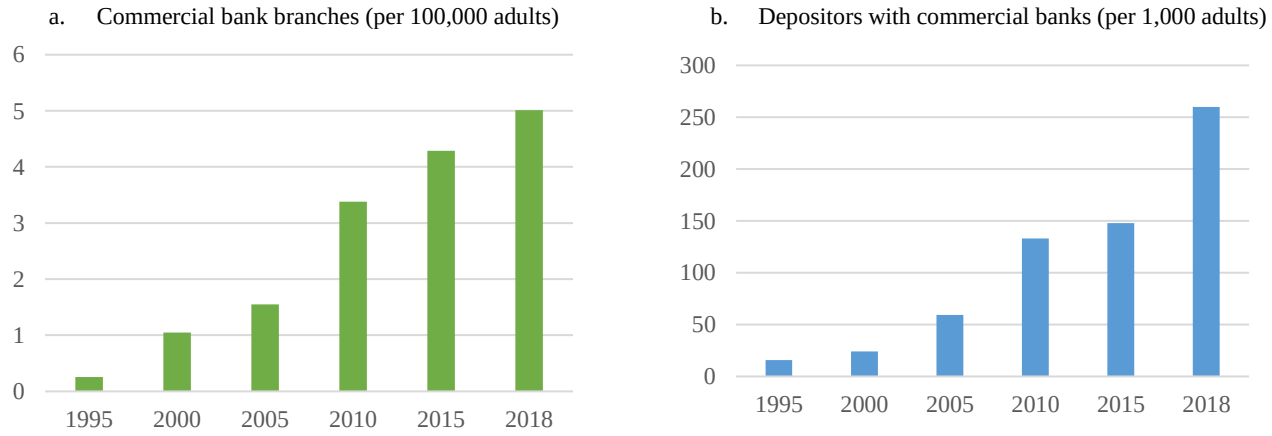
1. Introduction

Digital financial inclusion (DFI) is the use of digital technology to provide formal financial services at low costs to financially excluded and underserved poor populations. Digital financial services are financial services accessed and delivered through digital channels, including credit, savings, payments, remittances, and insurance. Digital channels refer to the internet, smartphones, ATMs, POS terminals, etc. In 2011, a United Nations report called on governments globally to finance broadband infrastructure and encourage internet connectivity with the goal of attaining the Millennium Development Goals (MDGs) by 2015, or else "lose the opportunity to reap the economic and social benefits that broadband brings" (UN Broadband Commission, 2011, p. 1). As a result, many African governments invested in these technologies as part of their national

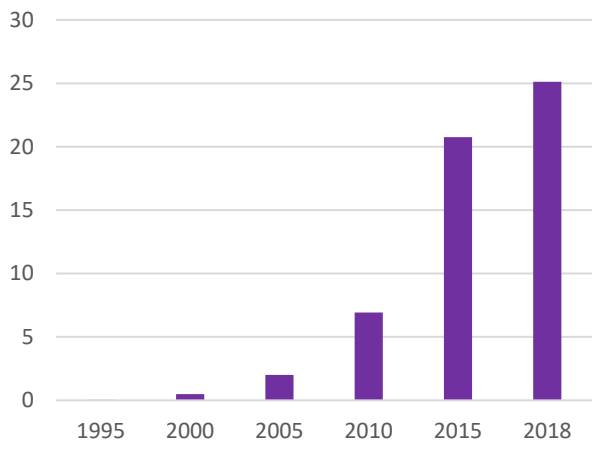
infrastructural plans. Examples are *South Africa's National Broadband* Policy and Nigeria's National Broadband Plan. Following the efforts at enabling broadband infrastructure, access to the internet has become gradually available. The availability has provided access to a surfeit of information and services that can produce benefits for education, finance, growth, and economic wellbeing (Broadbent & Papadopoulos, 2013; Evans, 2019).

The internet availability has also brought access to Internet-enabled phones to many across the African region. As a result, the continent has led the trend in mobile money services with more than 56 arrangements in place, especially Wizzit in South Africa and M-Pesa in East Africa. Particularly in Kenya, this mobile banking revolution is exemplified by the remarkable success since 2007 of M-PESA, a mobile phone-based money transfer, payment, and banking service. By 2018, M-Pesa has 28.5 million subscribers in East Africa able to transact with PayPal and Western Union. In South Africa, there are mobile money arrangements such as First National Bank with around 11.6 million customers, Wizzit with over 300,000 subscribers, Flash Mobile Cash by Eezi with a network of 160,000 subscribers, and MTN Mobile Money had 27 million active users in 14 markets. According to the World Bank's Global Findex Database, 21% of adults in the region have a mobile money account. Over half of all mobile money services in the world are in Africa, which is the fastest-growing mobile market in the world. Most indicators of digital financial inclusion are on the rise: commercial bank branches (per 100,000 adults), automated teller machines (per 100,000 adults), individuals using the Internet (% of population) and mobile cellular subscriptions (per 100 people) have grown over the years (See Figure 1). GDP per capita is gradually growing, but it is not translated into reduction in poverty and equality as the poverty headcount ratio at $1.90 a day is still substantial while the Gini index is still high in individual African countries (See Figure 2). The question, therefore, is: how can the increase in digital financial inclusion aid economic growth, as well as stem the tide of poverty and inequality in the continent?

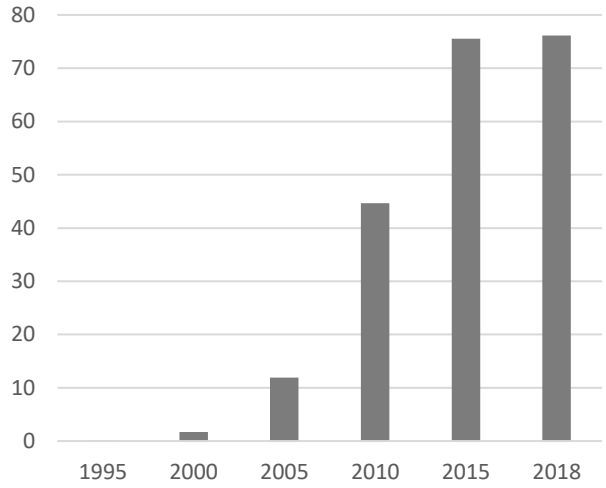
Figure 1. Evolution of digital financial inclusion indicators in Africa



a. Individuals using the Internet (% of population)



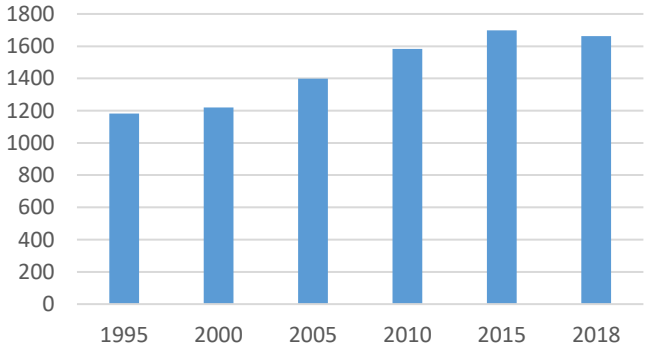
b. Mobile cellular subscriptions (per 100 people)



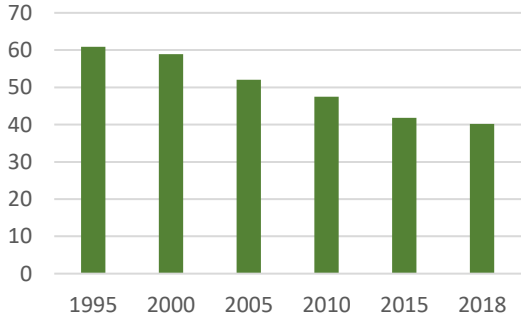
Source: Authors' Computation (2023)

Figure 2. Growth in GDP per capita, Income inequality and poverty in Africa

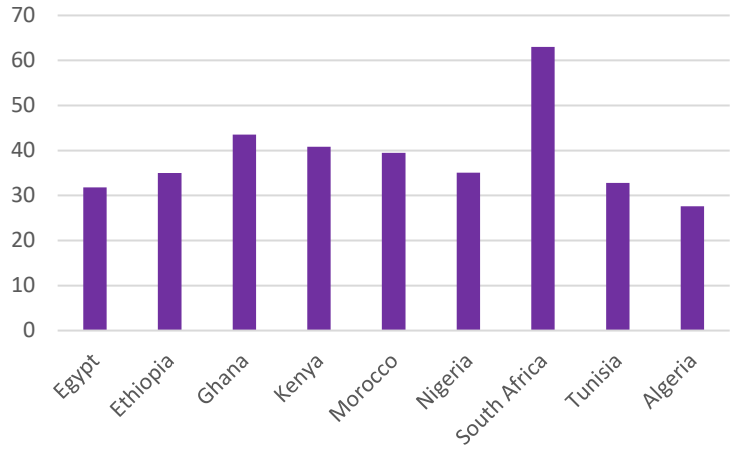
a. GDP per capita



a. Poverty headcount ratio at $1.90 a day



a. Gini Index (2015)



Source: Authors' computation (2023)

The increased adoption of digital financial services (DFI) in the continent has caused much speculation and optimism concerning its effects on inequality, poverty, and growth. The media, policymakers, and various studies have all flaunted the potentials of digital financial services (e.g., Ndemo & Weiss, 2016; Mazer & Rowan, 2016; Bongomi et al., 2018). It is true that the effects of DFI are important and fascinating at the same time. The earliest known studies on the effects of financial inclusion are Andrianaivo and Kpodar (2011), and Sarma and Pais (2011). Much of the subsequent literature focused on the empirical aspects of the effects of financial inclusion by considering various country groupings, data-sets, time periods, and different indicators of financial inclusion, and using a swarm of econometric techniques (e.g., Chiapa et al., (2016); Adeola & Evans, 2017; Evans, 2017; Evans & Alenoghena, 2017; Evans & Lawanson, 2017; Wale-Awe et al. 2020). Although numerous studies are available on the effects of financial inclusion, two fundamental gaps exist in the literature. First, there is little empirical evidence available on digital financial inclusion and its implications for economic growth, income inequality and poverty reduction. Second, a large part of the literature has been devoted to financial inclusion, to the detriment of the empirical evaluation of digital financial inclusion. In fact, in the case of Africa, empirical evidence is scarce and little data is available, until recently, for any significant insights for policy direction.

Considering the focus of this study, current issues, and the extant literature on digital financial inclusion on growth, income inequality and poverty reduction, this study investigates digital financial inclusion and the growth-inequality-poverty triangle in African countries. Understanding these links is important: with the growing initiatives in developing a digital economy in many African countries, it would be worthwhile to explore the effects of digital financial inclusion. It would be appropriate to place digital financial inclusion within the broader context of economic development in the continent. By examining these issues empirically, therefore, this study provides solid and conclusive evidence for policymakers. It will aid policymakers in designing and implementing programmes that will broaden access to digital financial services and thereby promote economic growth and stem the tide of inequality and poverty.

The study proceeds as follows. Section 2 reviews the theory and previous literature. Section 3 discusses the data, models, and econometric methodology. Section 4 presents the empirical results and discussion of results while Section 5 concludes with policy recommendations and directions for future research.

2. Theory and Literature Review

The endogenous growth model emphasizes the role of finance. A developed financial system broadens access to funds and reduces their costs, expands economic activities, and hence increases GDP (Evans & Lawanson, 2017). The advantages of an inclusive financial system are reduction of the cost of capital, efficient allocation of productive resources, reduction of informal sources of credit and improvement in the management of finances (Sarma & Pais, 2008). Equally, the theory of diffusion of innovations describes how, why, and at what rate new ideas and technology gains momentum and diffuses through a particular population or social system (Rogers, 1995; Dearing & Cox, 2018; Evans, 2018a)[1]. In line with the theory, the diffusion of digital financial products gained momentum in many contexts because adequate levels of technology affect the depths and ranges of financial service (transfers, savings, credit, insurance, and investments), standards of living, and economic growth (Evans, 2016; Evans, 2019; Siddik & Kabiraj, 2020).

Various scholars have debated the effects of digital technology (e.g., Niebel, 2018; Palvia et al., 2018). These studies have shown that digital technology such as mobile phones and the internet are important innovations for the financial sector (Pradhan et al., 2015; Pradhan et al, 2017: Wale-Awe, 2023). Digital technology has contributed to geographical diffusion of banking services and operational proximity of banks to local economies (Diniz et al., 2012). In the last two decades, digital technology arrangements have been responsible for branchless banking, internet banking, and mobile money, which are mainly associated with digital financial inclusion strategies in Africa. M-Pesa in Kenya is a good example of how digital technology can promote geographical expansion of banking services. Digital technology therefore presents a remarkable opportunity to connect millions of low-income populations to the formal financial marketplace (Weissbourd & Ventures, 2002).

Development economists suggest that, in the absence of inclusive financial systems, poor individuals and SMEs may defer key decisions as regards physical and human capital accumulation, not exploiting likely growth opportunities (Ashraf et al., 2010). Financial market imperfections, such as information asymmetry and transactions costs, can confine the poor to the "poverty trap", thus decreasing their opportunities and leading to unalleviated inequality and slow growth (Evans & Lawanson, 2017). A swiftly growing literature shows the beneficial effects of financial inclusion for individuals. For example, studies such as Evans and Lawanson (2017) have shown a range of models to explain how lack of access to finance can lead to inequality and poverty traps. The literature shows that provision of access to financial instruments spurs poverty reduction (Koomson et al., 2020; Wang & He, 2020), decline in inequality (Demir et al, 2020; Mohd et al., 2020), and economic growth (Nizam et al, 2020; Siddik & Kabiraj, 2020).

[1] Everett Rogers, a professor of communication studies, popularized the theory in his book Diffusion of Innovations.

Martinez et al. (2015) showed that financial inclusion reduces income inequality to a significant degree. Park and Mercado (2015) showed that financial inclusion lowers poverty and income inequality. Burgess and Pande (2005) showed that state-led expansion of rural bank branches in India has significantly reduced poverty; and opening bank branches in rural unbanked locations has reduced poverty rates. Similarly, Brune et al. (2011) showed that increased financial access through commitment savings account improves the welfare of poor households in rural Malawi; and increased financial access affords easy access to their savings for agricultural input use. Adeola and Evans (2017) showed that financial inclusion, in terms of financial access and usage, has positive significant effects on economic diversification. Evans and Lawanson (2017) evaluated the causal links between financial inclusion and economic output, and between financial inclusion and the five sectors of the Nigerian economy using cointegration and Granger causality tests. They found bi-directional causality between financial inclusion and the aggregate economy, and between financial inclusion and the sectors of the economy as well. Diniz et al. (2012) showed that financial inclusion positively contributes to local socio-economic development.

In a particularly important study, Hariharan and Marktanner (2013) showed that a 10 percent increase in financial inclusion has the potential to increase income per worker on average by 1.34 percent. Financial inclusion boosts the efficiency of financial intermediation, the amount of available savings, and new business opportunities. According to the authors: "State sponsored universal banking has therefore contributed to greater economic diversification in rural areas than is the case in more competitive banking environments" (p. 4). Using data for 123 countries and over 124,000 individuals, Allen et al. (2016) showed that increased financial inclusion is associated with an enabling environment to access financial services, such as greater proximity to branches, lesser documentation in the opening of an account, and lesser banking costs. They showed that, for rural residents and the poor, policies aimed at promoting inclusion are especially effective.

Many other studies investigated the issue of the growth-inequality-poverty triangle (e.g., Shoukry et al., 2018; Zaman & Shamsuddin, 2018; Michálek & Výbošťok, 2019; Zaman et al., 2020;). However, it is evident that none of the studies devote any empirical attention to the relationship between digital financial inclusion and the growth-inequality-poverty triangle. Conclusively, many studies have investigated the measures, determinants, and effects of financial inclusion on growth, inequality, and poverty. These studies have laid the foundations; however, none of the studies have investigated the effects of digital financial inclusion on the growth-inequality-poverty triangle, especially for Africa. This study fills the gap.

3. Data and Methodology

3.1 Data

This study is based on annual panel data covering the period from 1995 to 2018 for 42 African countries. The data are sourced from the World Bank's (2020) World Development Indicators database, except data on institutional variables collected from Worldwide Governance Indicators. World Development Indicators and Worldwide Governance Indicators have the most up-to-date

global development and governance database respectively, broadly used in the modern economic literature for their international comparability (see Pinkovskiy & Sala-i-Martin, 2016; Javed et al., 2018). The African countries included in the sample are Algeria, Angola, Botswana, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Republic of the Cote d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, and Zimbabwe.

3.2 Model Specification

In line with the literature on growth-inequality-poverty (e.g., Dhrifi, 2015; Michálek & Výbošťok, 2019; Zaman, 2020), the exploration of the effects of digital financial inclusion on growth-inequality-poverty triangle requires simultaneous regression equations (i.e., growth equation, inequality equation, and poverty equation). The three equations are modelled as a function of digital financial inclusion and a set of control variables commonly used as factors explaining growth, poverty, and inequality:

$$Gdpcg_{it} = \beta_0 + \beta_1 Dfi_{it} + \beta_2 Pov_{it} + \beta_3 Gini_{it} + \beta_4 Trd_{it} + \beta_5 Gov_{it} + \beta_4 Hum_{it} + \beta_5 Infr_{it} + \mu_{it} \quad (1)$$

$$Pov_{it} = \alpha_0 + \alpha_1 Dfi_{it} + \alpha_2 Gdpcg_{it} + \alpha_3 Gini_{it} + \alpha_4 Pop_{it} + \alpha_5 Infl_{it} + \in_{it} \quad (2)$$

$$Gini_{it} = \lambda_0 + \lambda_1 Dfi_{it} + \lambda_2 Gdpcg_{it} + \lambda_3 Gdpcg_{it}^2 + \lambda_4 Pov_{it} + \lambda_4 Ins_{it} + \varphi_{it} \quad (3)$$

Where *Gdpcg* represents annual growth of real GDP per capita; *Dfi* represents digital financial inclusion; *Pov* represents poverty measured by poverty headcount ratio at $1.90 a day; *Trd* represents trade openness; *Pop* represents population growth; *Gini* represents income inequality measured by the Gini index; *Infr* stands for infrastructure measured by gross capital formation (% of GDP); *Infl* represents inflation; *Hum* represents human capital measured by secondary school enrolment; and *Ins* represents institutions.

Included in the growth equation are macroeconomic variables commonly used in empirical studies that determine growth: growth of the consumer price index (to control for the macroeconomic environment) (i.e., inflation), trade openness, distribution of inequality, government spending and human capital. In the poverty equation, poverty is modelled as a function of a set of control variables commonly used in the literature as factors explaining poverty: population growth captures population expansion, income inequality captures the kind of distribution of income, GDP per capita growth captures economic development, and gross capital formation (% of GDP) as indicator to measure the quality of infrastructure. In the inequality equation, introduced are the growth rate of the GDP per capita and its square to test for Kuznets (1955) hypothesis. Also included are institutions reflecting how the distribution of income is made. The institutions index is constructed by applying the method of principal component analysis on six governance indicators: political stability and absence of violence, voice and accountability, control of

corruption, rule of law, regulatory quality, and government effectiveness. The six governance indicators are the most typically used in the literature, as the data are readily available.

In line with the objectives of this study, digital financial inclusion is the only explanatory variable common to the three equations. It likely affects simultaneously, in diverse ways, the three endogenous variables. Observe that digital financial inclusion is a composite concept which no single variable can capture. In the literature, there are three commonly used financial inclusion indicators: (i) depositors with commercial banks per 1000 adults; (ii) commercial bank branches (per 100,000 adults); and (iii) automated teller machines (per 100,000 adults) (see Adeola & Evans, 2017; Ogbeide, 2019). Along the same lines, there are two commonly used information communications technology (ICT) indicators in the literature: mobile penetration (% of population) and internet usage (% of population) (see Evans, 2019; Vincent & Evans, 2019). Using principal component analysis, the digital financial inclusion index (DFI) is constructed from the three financial inclusion and the two ICT indicators: depositors with commercial banks per 1000 adults, automated teller machines (per 100,000 adults), commercial bank branches (per 100,000 adults), internet usage (% of population) and mobile penetration (% of population). Theoretically, the virtues of this computed index of digital financial inclusion are: (i) it retains most of the information in the original dataset; and (ii) it captures the demand and supply side of an inclusive financial system[2].

3.3 Econometric Techniques

The two-step system generalized method of moments (GMM) versus the default one-step approach are used for the empirical analysis. The rationale is that the standard covariance matrix of the two-step technique is robust to panel-specific autocorrelation and heteroscedasticity. As developed by Arellano and Bover (1995), and Blundell and Bond (1998), system GMM estimator combines differences with the regression in levels and uses the lagged values of the dependent and other explanatory variables as the instruments for the regression in differences and the lagged differences of the explanatory variables as the instruments for the regression in levels (Evans et al, 2018). The merit of the system GMM is that it rules out the problems of heteroscedasticity, autocorrelation, reverse causality, and biasedness from the omission of explanatory variables.

4. Results and Discussion

The descriptive statistics of the variables of interest for the 42 African countries are presented in Table 1. The averages of the index of digital financial inclusion, GDP per capita growth, Gini Index and

poverty headcount ratio are 0.36, 2.81%, 41.49 and 50.22 respectively. The standard deviation is a measure of the amount of variation of a set of data values. For the sample of 42 countries, the standard deviations of digital financial inclusion, GDP per capita growth, Gini Index and poverty headcount ratio are high, depicting the level of inequalities. In addition, the correlation matrix of the variables is presented in Table 2. None of the values of the correlation coefficients between

[2] Depositors with commercial banks per 1000 adults and commercial bank branches (per 100,000 adults) are a demand side indicator while automated teller machines (ATMs) (per 100,000 adults) is a supply side indicator.

the explanatory variables is more than 0.7, meaning that multicollinearity would not be a problem in the estimations[3].

Table 1. Descriptive Statistics

	Mean	Median	Std. Dev.
Dfi	0.36	0.25	1.26
Gdpcg	2.81	2.67	3.73
Gini	41.49	40.98	5.05
Gov	15.90	15.46	5.76
Hum	49.44	43.82	24.42
Infl	6.41	5.27	5.56
Infr	23.58	22.48	10.02
Ins	0.59	0.59	2.02
Popg	2.23	2.56	0.89
Pov	50.22	39.75	5.86
Trd	58.29	53.47	24.57

Source: Authors' computation (2023)

Dfi = Index of digital financial inclusion; Gdpcg = GDP per capita growth (annual %); Gini = Gini Index; Gov = General government final consumption expenditure (% of GDP); Hum = secondary school enrollment; Infl = Inflation (annual %); Infr = Gross fixed capital formation (% of GDP); Ins = Index of institutions; Popg = Population growth (annual %); Pov = Poverty headcount ratio at $1.90 a day; Trd = Trade (% of GDP).

Table 2. Correlation Matrix

	Dfi	**Gdpcg**	**Gini**	**Gov**	**Hum**	**Infl**	**Infr**	**Ins**	**Popg**	**Pov**	**Trd**
Dfi	1.00										
Gdpcg	0.07	1.00									
Gini	-0.07	-0.45	1.00								
Gov	0.17	0.09	-0.11	1.00							
Hum	0.56	0.01	0.28	0.13	1.00						
Infl	-0.11	0.11	-0.04	-0.14	-0.09	1.00					
Infr	0.08	0.12	-0.27	0.15	0.03	-0.25	1.00				
Ins	0.32	0.00	0.16	0.40	0.52	-0.13	0.08	1.00			
Popg	-0.39	-0.06	-0.21	-0.24	-0.55	0.12	0.11	-0.60	1.00		
Pov	-0.51	-0.09	0.50	-0.06	-0.55	-0.09	-0.06	0.58	-0.70	1.00	
Trd	0.19	0.15	0.35	0.43	0.20	-0.08	0.33	0.27	-0.25	0.27	1.00

Source: Authors' computation (2023)

Dfi = Index of digital financial inclusion; Gdpcg = GDP per capita growth (annual %); Gini = Gini Index; Gov = General government final consumption expenditure (% of GDP); Hum = secondary school enrollment; Infl = Inflation (annual %); Infr = Gross fixed capital formation (% of GDP); Ins = Index of institutions; Popg = Population growth (annual %); Pov = Poverty headcount ratio at $1.90 a day; Trd = Trade (% of GDP).

[3] Multicollinearity occurs when the explanatory variables in a regression model are correlated. If correlation between variables is too high, the resulting multicollinearity may increase the variance of the coefficient estimates and make the estimates very sensitive to minor changes in the model.

The system GMM estimates are reported in Table 3. At the bottom of the table are two diagnostics tests used to provide statistical performance: the autocorrelation and the validity of the instruments. AR (2) is the Arellano-Bond test for autocorrelation of second order. Hansen-J-test is used to test for over-identifying restrictions. The results reported in Tables 3 and 4 provide good statistical performance. The estimation results show that digital financial inclusion has significant negative effects on poverty and inequality, but significant positive effects on growth of GDP per capita, implying that increase in digital financial inclusion is associated with reduction in poverty and inequality, but increase in economic growth. This result highlights that access to financial services such as savings, loans, insurance, etc., through digital channels generates positive effects on the lives of the poor, helping them to come out of the clutches of poverty. These findings are consistent with the literature which has shown that communities with access to financial instruments easily experience increased savings, increased consumption, productive investments, and female empowerment (Ashraf et al., 2010; Gyeke-Dako et al., 2017). It means that significant benefits can be reaped by pursuing a massive digital financial inclusion drive. With access to various digital financial products and services, households can take advantage of investment opportunities, allocate resources more efficiently, and thus improve their living standards (Abor et al., 2018).

Table 3. **System GMM Estimates (Robust two-step)**

	Poverty	Growth	Inequality
Lagged dependent variable	0.480*** (0.001)	0.976*** (0.003)	0.024*** (0.001)
Digital financial inclusion	-0.138*** (0.002)	0.513*** (0.050)	-0.227*** (0.006)
Growth rate of GDP per capita	-0.892*** (0.115)	-	-0.528*** (0.026)
Square of the growth rate of GDP per capita	-	-	0.846*** (0.001)
Income inequality	0.967*** (0.005)	-0.133*** (0.002)	-
Poverty	-	-0.024*** (0.001)	0.098*** (0.004)
Population growth	0.396*** (0.003)	-	
Human capital	-	0.044** (0.025)	-
Infrastructure	-	0.354 (0.255)	-
Trade openness	-	0.031 (0.040)	-
Government spending	-	0.161*** (0.006)	-
Inflation	0.008 (0.008)	-	-
Institutions	-	-	0.239*** (0.002)
Hansen-J-Test	41.912	38.193	39.502
AR(2)	-2.745	-1.270	-0.156

Source: Authors' computation (2023)

*, ** and *** denote the significance level of 10%, 5% and 1% respectively. ( ) denote standard errors.

The growth of GDP per capita has a negative and significant effect on poverty and inequality, meaning that increased economic growth gives rise to reduction in poverty and inequality. This result is consistent with the results of Dhrifi (2015), in which increased levels of growth rates are associated with decreased levels of poverty. The Kuznets hypothesis is confirmed in the inequality equation. Indeed, the results show that the rate of growth increases inequality in the short term, for the long term, the rate of growth reduces inequality. It is believed that in African countries

generally, being characterized by the weakness of their political institutions, the benefits of growth are not distributed in the most egalitarian manner.

Equally, the results show that income inequality has positive significant effects on poverty but negative significant effects on growth, implying that an increase in the level of inequality intensifies poverty and diminishes economic growth. This suggests that an effective means of poverty reduction is reducing inequalities by way of redistribution of wealth. Low inequality can benefit the poor in two ways: by increasing growth of income, and by letting the poor share more in that growth. In other words, African countries would experience lower poverty if inequality is low. By the same token, poverty has negative significant effects on inequality but positive significant effects on growth, implying that an increase in the level of poverty fuels inequality and lessens economic growth. The implication of this finding is that African country should deepen their efforts into poverty reduction to stimulate the rate of economic growth and reduce inequality. In this direction, structural reforms could contribute to reduce poverty in the continent.

The results also show that institutions have negative and significant effects on inequality. This result is somewhat logical since the quality of governance affects the interactions between economic agents in terms of property rights, administrative procedures, and operations of the public sector. Sound institutions give rise to a fairer redistribution which may help reduce inequalities (Dhrifi, 2015). Moreover, human capital has a positive and significant effect on economic growth; this means that an increase in the level of human capital fuels economic growth. The growth of the economy is dependent in large part on human capital – education, skills, and abilities (Siddiqui & Rehman, 2017; Matousek & Tzeremes, 2019). As a result, it is essential for the government to increasingly raise the levels of human capital through education and training, which are seen as important factors in fuelling economic growth. Equally, government spending has a positive and significant effect on economic growth; this means that an increase in the level of government spending stimulates economic growth. According to the Keynesian theory, government spending has positive effects on economic growth; the more a government spends, the higher the economic growth is, because of the expansionary fiscal policy (Romer, 1986). The idea is that as government spending increases, production rises, leading to increase in aggregate demand, and therefore, increased levels of GDP (Nyasha & Odhiambo, 2019).

As mentioned earlier, to ascertain that the estimates are robust, one-step GMM is used to re-examine the relationships, to establish that the results are not sensitive to different estimation methods. The results of the further estimations are presented in Table 4. As expected, one-step GMM yields quite comparable results. Consequently, it is believed that different estimation methods do not pose a threat to the findings.

Table 4. System GMM Estimates (Robust one-step)

	Poverty	Growth	Inequality
Lagged dependent variable	0.481*** (0.147)	0.976*** (0.018)	0.023** (0.010)
Digital financial inclusion	-0.138*** (0.045)	0.481*** (0.050)	-0.227*** (0.006)

Growth rate of GDP per capita	-0.900* (0.589)	-	-0.542 (0.915)
Square of the growth rate of GDP per capita	-	-	0.846** (0.366)
Income inequality	0.972*** (0.159)	-0.134* (0.073)	-
Poverty	-	-0.024** (0.012)	0.098*** (0.018)
Population growth	0.418 (0.632)	-	-
Human capital	-	0.042** (0.021)	-
Infrastructure	-	0.361 (0.203)	-
Trade openness	-	0.036 (0.772)	-
Government spending	-	0.161*** (0.011)	-
Inflation	0.001 (0.010)	-	-
Institutions	-	-	0.237** (0.012)
Hansen-J-Test	43.007	36.463	40.193
AR(2)	-2.097	-1.135	-0.169

Source: Authors' computation (2023)

*, ** and *** denote the significance level of 10%, 5% and 1% respectively. ( ) denote standard errors.

To buttress the system GMM estimates, the study proceeds to causality test. From the estimation of the Toda Yamamoto causality test (see Table 5), the results attain a kaleidoscopic character, which is as follows: there is unidirectional causality flowing from digital financial inclusion to growth and inequality while bi-directional causality exists between digital financial inclusion and poverty. Interestingly, there is bi-directional causality between growth and inequality, growth, and poverty, and between inequality and poverty. These findings are comparable to studies such as Shoukry et al. (2018), Michálek and Výbošťok (2019), and Zaman et al. (2020). Overall, the evidence establishes the causal relation between digital financial inclusion and the growth-inequality-poverty triangle, as shown in Figure 3. The implication is that increase in financial services via digital channels can increase income levels, alleviate poverty, and aid distribution of income.

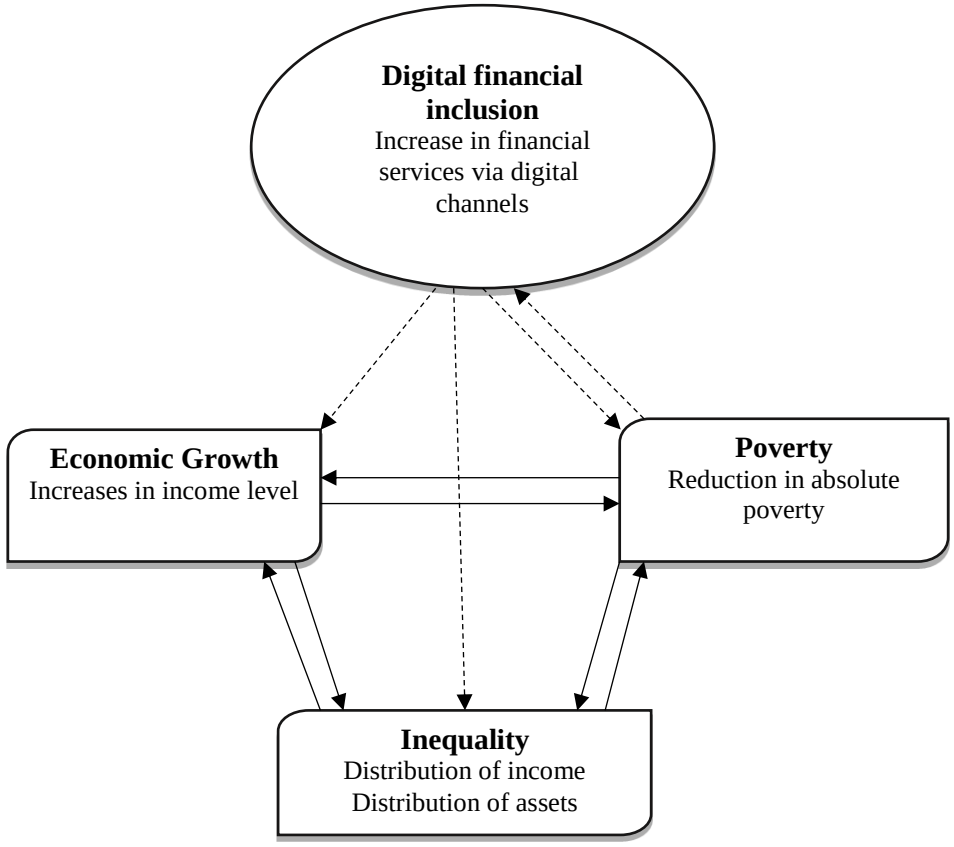
Table 5. Toda Yamamoto Causality Test Results

	Dependent variables			
	Digital financial inclusion	Growth	Inequality	Poverty
Digital financial inclusion	-	20.750***	14.652**	158.274***
Growth	6.503	-	21.873***	210.999***
Inequality	4.944	16.959***	-	297.652***
Poverty	22.021***	12.866**	19.296***	-

Source: Authors' computation (2023)

*** and **** denote the significance level of 5% and 1% respectively.*

Figure 3. Digital financial inclusion and the growth-inequality-poverty triangle



Source: Authors' conception (2023)

5. Concluding Remarks

The study has assessed the role of digital financial inclusion on the growth-inequality-poverty triangle in a panel of 42 African countries for the period 1995 to 2018. The findings of the study highlight the significance of digital financial inclusion for the growth-inequality-poverty triangle; digital financial inclusion has significant negative effects on poverty and inequality, but significant positive effects on growth of GDP per capita, implying that increase in digital financial inclusion is associated with reduction in poverty and inequality, but increase in economic growth. The implication is that digital financial inclusion can promote economic growth, as well as alleviate poverty and stem the tide of inequality. The growth of GDP per capita has a negative and significant effect on poverty and inequality, meaning that increased economic growth gives rise to reduction in poverty and inequality. The Kuznets hypothesis is confirmed in the inequality equation; the rate of growth increases inequality in the short term, for the long term, the rate of growth reduces inequality. Equally, the results show that income inequality has positive significant

effects on poverty but negative significant effects on growth, implying that an increase in the level of inequality actually intensifies poverty and diminishes economic growth. By the same token, poverty has negative significant effects on inequality but positive significant effects on growth, implying that an increase in the level of poverty actually fuels inequality and lessens economic growth.

In what follows, policy implications are discussed. The study has clearly established that digital financial inclusion has significant negative effects on poverty and inequality, but significant positive effects on the growth of GDP per capita. These findings evidently highlight the positive growth effects and the positive income redistributive effects of digital financial inclusion. Considering the high levels of poverty and inequality in the continent as earlier highlighted in Figure 2, the promotion and campaign of digital financial inclusion are imperative to policy makers. Consequently, policies targeted at fostering digital financial inclusion should be stimulated. The findings imply that improving digital access to financial services across poor and vulnerable populations is essential to address poverty. The literature has suggested that economic empowerment for marginalized citizens by boosting access to formal financial services is a powerful tool to achieve equitable development (Rosengard, 2016). Well-functioning financial systems promoting digital access to credit, savings, insurance, and other banking have the potential to benefit the poor. The study recommends that African governments create enabling environments for digital financial services to operate soundly to facilitate the provision of credit or loan facilities to the poverty-prone communities. Through the deployment of innovative digital financial products and services, the scope of financial operations should be widened to reach the poor to alleviate poverty and inequality. Equally, to reduce poverty and inequality in the African region, the central banks and policymakers must implement policies that will address obstacles to digital financial inclusion. In view of this, it is important to educate Africans on the use of digital financial services and products. Digital financial products and services must be brought close to the rural areas with proper education on use and functions.

Future studies can improve on the extant literature by exploring whether the established findings withstand empirical analysis within country-specific settings. Such line of enquiry is necessary for more policy-targeted implications for individual countries. Moreover, assessment of the underlying linkages through all the conditional distributions of economic growth, income inequality and poverty reduction could provide better insights into the investigated interrelationships. Hence, it is advisable for future studies to tailor growth-inequality-poverty specifications such that, they accentuate countries with low, intermediate, and high levels of economic growth, income inequality and poverty. In essence, wholesale policies reliant on mean regional values of economic growth, income inequality and poverty may prove abortive unless they are aligned with existing levels in individual countries.

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