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Financial Inclusion and Economic Growth in Sub-Saharan Africa—A Panel ARDL and Granger Non-Causality Approach

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Abstract: Many earlier development finance studies have attempted to assess the relationship between financial inclusion and economic growth. However, the findings of these studies vary from economy to economy and region to region due to various social and economic factors. We, therefore, deemed it pertinent to examine the relationship between financial inclusion and economic growth while further identifying the direction of causality between the two variables in twenty-six (26) Sub-Saharan African (SSA) economies using annual secondary data over the 2000–2019 period. In our paper, we used the principal component analysis (PCA) technique to develop a single composite index to proxy financial inclusion while adopting panel unit root, system generalised method of moment (GMM), and ARDL cointegration tests to assess the stationarity properties, assess the factors that affect economic growth, and examine the long-run relationships between financial inclusion and economic growth, respectively. In addition, a Granger non-causality test is used to verify the direction and magnitude of causality. Our study revealed that financial inclusion and economic growth share a strong long-run relationship and that there is bi-directional causality, indicating synergy between these two variables. In order to ensure sustainable economic growth, we thus recommend that developing countries develop macroeconomic policies that will promote financial inclusion while enhancing the functioning and regulation of the domestic financial markets to ensure that all citizens are catered for in the available instruments, products, and service offerings. Within the same policy framework, efforts must be made to further support productive sectors of the economy to ensure economic growth.

Keywords: financial inclusion; sustainable economic growth; principal component analysis (PCA); panel unit root test; cointegration test; system GMM; Granger non-causality test

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1. Introduction

Contemporary economic theories advocate the importance of finance for inclusive economic growth (see McKinnon 1973; King and Levine 1993; Levine 2005). Financial inclusion is one of the key catalysts for most of the UN Sustainable Development Goals (SDGs) and the AU Agenda 2063. In addition, high-level economic growth is one of the prime objectives of most developing economies, including Sub-Saharan African countries. As a result, a large number of developing economies have prepared a financial inclusion strategy that helps to expand the sources of funding, limits informal financial services, and promotes investment and thereby economic growth (Zins and Weill 2016; Demirgüç-Kunt et al. 2018). An inclusive financial system helps financial services reach the unbanked segments of society and promotes business expansion (Beck et al. 2007; Mehrotra and Yetman 2015; Owen and Pereira 2018; Asante et al. 2023). Access to financial services is critical to mobilising financial resources, promoting investments, and thereby value creation for start-ups and small businesses, with positive spillover effects on socioeconomic development (Park and Mercado 2015; Kim 2016; Nanda and Kaur 2016).

Financial inclusion raises household income and thereby improves the economic well-being of households and enhances the business activities of small enterprises (Naceur et al. 2017).

Financial services such as payments, transfers, savings, and credit facilitate business and personal transactions and thus promote economic growth. Bank accounts held in formal financial institutions—such as a commercial bank, credit union, microfinance institution (MFI), or mobile money service provider—allow households and businesses to store, send, and receive money safely and at a low cost (Demirgüç-Kunt et al. 2017; Mehrotra and Yetman 2015). It is therefore necessary to have a well-functioning financial market to achieve sustainable economic growth. Contemporary empirical evidence suggests that the structure of an economy has its own impact on the relationship between financial development and economic growth (Ibrahim and Alagidede 2018; Sohag et al. 2015). In addition, financial development complements economic growth when there are clear channels or linkages and supportive regulatory frameworks. Otchere et al. (2017) argued that financial sector reforms and policy decisions should incline towards an inclusive financial system and not only savings and capital mobilisations.

Unlike other regions, Sub-Saharan Africa has the least developed economies. It is also a region with low levels of financial inclusion, where only 43% of adults have a bank account. This indicates that a large number of adults in the SSA region do not have access to financial services, implying a high level of financial exclusion (Makoni 2014; Demirgüç-Kunt et al. 2018). Given the importance of finance for economic growth, a low level of financial inclusion is identified as one of the reasons for the high levels of poverty and inequality in the region (Park and Mercado 2015). However, the literature revealed a mixed result on the relationship between financial inclusion and economic growth. Some studies found a significant positive relationship between finance and economic growth (Kim et al. 2018; Makina and Walle 2019; Dahiya and Kumar 2020), while others found the opposite (Seven and Yetkiner 2016; van Wyk and Kapingura 2021). On the other hand, several scholars argue that finance promotes economic growth, thus supporting the supply-leading hypothesis (Patrick 1966; Revell and Goldsmith 1970; King and Levine 1993). However, others argue that it is economic growth that will create demand for finance and financial services (Robinson 1979). In addition, there are scholars who argue that there is a synergy between financial inclusion and economic growth (Sethi and Acharya 2018; Chima et al. 2021; Jima and Makoni 2023). Inconsistent findings on the causality between financial inclusion and economic growth in different contexts call for additional research in the area and supplement the few studies undertaken in SSA (An et al. 2021). It is this lack of consensus amongst academicians that has motivated this research with the aim to shed more light on the nexus between financial inclusion and economic growth in the SSA, with a specific interest in the direction of causality between the two variables.

The remainder of this paper is organised as follows: The literature review considers the theories that underpin finance and economic growth, supported by existing empirical evidence. This is followed by a brief discussion on the methodological approach adopted in addressing the burning issue under assessment herein. The results and discussion of findings are laid out in Section 4, while the paper ends with a conclusion and recommendations emanating from this study.

2. Literature Review

2.1. Theoretical Foundation—Finance and Economic Growth

In the old literature of economic theories, there were very few attempts to examine the nexus between finance and economic growth. However, several contemporary economic theories explain the relationship between finance and economic growth. Schumpeter (1911) was the first to examine the link between finance and economic growth. Some of the most common theories related to finance and economic growth include the demand-following hypothesis, the supplying-leading hypothesis, and the law and finance theory. Robinson (1979) was prominent in the demand-following hypothesis and argued that economic growth plays a critical role in realising financial inclusion through enhancing

the demand for financial services. Robinson (1979) indicated that, in any case, it is the enterprise that leads finance. Expansion in economic activities leads to a new demand for financial services and an increase in the demand for financial services, which in turn enhances economic growth (Robinson 1979). Several studies tested the demand-following hypothesis and argued that this theory is more effective in developing economies than in the developed world (Naceur and Ghazouani 2007; Samargandi et al. 2014).

Patrick (1966), Revell and Goldsmith (1970), and McKinnon (1973), on the other hand, were the proponents of the supplying-leading hypothesis and advocated the importance of finance for economic growth. In line with this theory, finance promotes innovations and entrepreneurship that enhance economic growth. The financial sector plays an important role in mobilising the financial resources necessary for investment and thereby promoting economic growth. Levine and Zervos (1998) identified three main channels: the level of intermediation, efficiency, and composition, as a means through which finance influences economic growth. In this theory, financial development enhances economic growth by availing financial resources to the economic sector with resource constraints (Hsueh et al. 2013). Patrick (1966) argued that the financial system can influence economic growth in three important ways. First, the financial system stimulates changes in ownership through financial intermediation among the different asset holders. Second, financial institutions promote the transfer of funds and the efficient allocation of resources from relatively low to relatively more productive uses. Third, financial institutions contribute to the rise in the rate of capital accumulation if there exists a convenient environment for business transactions, saving, and investment, which incentivizes individuals and businesses to work, save, and invest. Against this argument, it is possible to conclude that the existence of financial institutions and services precedes realising economic growth (Beck and Levine 2004; Odhiambo 2009; Ibrahim and Alagidede 2018).

In line with the above theories, the causality between financial inclusion and economic growth can be expressed by the supply-leading or demand-following hypotheses. In addition to the above two contrasting theories, there are scholars who argue for the existence of bidirectional causality between financial inclusion and economic growth. As per the bidirectional hypothesis, there is a direct relationship between the two theories, which indicates the complementarity of the supply-leading and demand-following hypotheses (Demetriades and Hussein 1996; Greenwood and Smith 1997; Harrison et al. 1999). Still, others argue for the existence of an independent hypothesis that indicates no causality between financial inclusion and economic growth (Lucas 1988; Stern 1989). On the basis of the above theories, it is possible to conclude that the theories on the causation between finance and economic growth do not apply uniformly to all economies and regions and thus need further investigation.

2.2. Empirical Studies—Financial Inclusion and Economic Growth

Many studies have been undertaken to assess the nexus between financial inclusion and economic growth. However, the findings of the studies vary from economy to economy and region to region due to various social and economic factors. A number of scholars confirmed that a rise in the level of financial inclusion exerts a positive impact on the socioeconomic development of many developing countries (Al-Moulani and Alexiou 2017; Benczúr et al. 2019; Afonso and Blanco-Arana 2022; Asante et al. 2023). Financial inclusion promotes economic growth by enhancing the average productivity of capital, channelling investment funds to economic entities, and increasing savings. Elias and Worku (2015) analysed the causality between economic growth and domestic savings in East African countries and found a significant positive and uni-directional causality for Ethiopia and Uganda. Campos et al. (2012) identified that financial innovation has a positive long-run effect on economic growth in Argentina. Financial inclusion boosts economic growth by enhancing savings and diversifying the sources of finance (Dabla-Norris et al. 2015; Iqbal and Sami 2017; Sharma 2016).

Lenka and Sharma (2017) found a significant positive association between financial inclusion and economic growth, both in the short and long run. Gourène and Mendy (2017) used financial services penetration and use to examine the causality between financial inclusion and economic growth in the West African Economic and Monetary Union (WAEMU) and found no causality at a scale between two and four years. However, there is bi-directional causality between economic growth and financial inclusion when the scale is four to eight years. Makina and Walle (2019) indicate that an inclusive financial system promotes economic growth in Africa. Balele (2019) found a positive correlation between financial inclusion and economic growth, suggesting the need for the SSA countries to focus on financial service expansion and leveraging innovation. Ibrahim and Olasunkanmi (2019) and Nanziri (2016) argued that the sustainability of economic growth can be realised only if a large proportion of the population has access to formal financial services. Dahiya and Kumar (2020) found a significant positive relationship between finance and economic growth, promoting financial service expansion. Kim et al. (2018) found that, despite disparities in the level of financial inclusion across the Organization of Islamic Countries (OIC), financial inclusion promotes economic growth.

On the other hand, there are scholars who have found a negative relationship between financial inclusion and economic growth. Seven and Yetkiner (2016) investigated the role of financial inclusion in economic growth in low-, middle-, and high-income countries and found a significant negative relationship in high-income countries. van Wyk and Kapingura (2021) found that, in the long run, saving has a negative effect on economic growth in South Africa because of the low rate of domestic savings and the country's greater reliance on foreign savings in the form of foreign direct investment (FDI), official development assistance (ODA), and cross-border bank flows. In addition, the Granger causality tests revealed that the relationship runs from economic growth to gross domestic savings, promoting the importance of raising investment if the country is to achieve sustainable economic growth. Kapingura et al. (2022) assessed the effect of financial sector development on macroeconomic volatility in the Southern African Development Community (SADC) region and found that banking sector indicators and capital market development have a significant negative effect on economic growth volatility, suggesting that a well-developed capital market and banking sector are important to mitigate macroeconomic volatility.

Other contemporary scholars have argued that there is a non-linear inverted U-shape relationship between finance and growth, indicating the existence of a turning point in the effect of finance on investment and consumption loans. While investment loans benefit economic growth, consumption loans impede it. Sahay et al. (2015) found a positive bell-shaped relationship between financial depth and economic growth, suggesting that there is a threshold where the returns to growth fall as financial depth increases. Cecchetti and Kharroubi (2012) identified that the turning point of growth in terms of private credit is close to 90% of GDP. Law and Singh (2014) identified that finance promotes growth until a threshold of finance to GDP ratio reached about 88%. Otherwise, the impact of finance on growth will turn negative as financial inclusion exceeds the threshold. Shahbaz et al. (2017) identified a nonlinear relationship between financial development and economic growth in India and argued that only negative shocks to finance have impacts on economic growth.

Several other researchers found a bi-directional causality between financial inclusion and economic growth in different countries and regions, indicating the complementarity of the 'demand-following' and 'supply-leading' hypotheses and encouraging regulators to follow a holistic approach while undertaking a financial reform that promotes economic developments (Chima et al. 2021; Arayssi et al. 2019; Fan et al. 2018). Sethi and Acharya (2018) indicated the existence of a bi-directional causality between financial inclusion and economic growth in both developed and developing economies. Odhiambo (2009), on the other hand, found unidirectional causality and argued that economic growth Granger causes financial development, so as to reduce poverty in South Africa. Ganti and Acharya (2017)

identified that financial inclusion creates more output in the case of supply-leading than demand-following hypotheses.

The empirical evidence above suggests that there is variation in the relationship between financial inclusion and economic growth. Some of the studies support the supply-leading hypothesis, while others promote the demand-following theory. In addition, some of the studies concluded that a significant negative relationship exists between the two variables, while others support a significantly positive relationship. Other studies still indicated that financial inclusion has a positive influence on the performance of the economy up to a certain level, which also varies from economy to economy and region to region. Furthermore, there is variation in the direction of causality between financial inclusion and economic growth. It is, thus, pertinent to examine the nexus between financial inclusion and economic growth and identify policy frameworks that will help enhance investment opportunities and economic growth in developing economies.

3. Methods and Data

This research applied a quantitative approach, wherein an econometric technique was used to analyse the nexus between financial inclusion and economic growth. This study employed panel data analysis techniques on the annual secondary data of twenty-six (26) selected Sub-Saharan African (SSA) countries sourced from the databases of the World Bank (WB) and the International Monetary Fund (IMF), respectively, spanning 20 years over the 2000–2019 period. The SSA countries that are included in this study are Angola, Botswana, Burundi, Cameron, Chad, the Democratic Republic of Congo, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Malawi, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, and Zambia. Selection of these countries was made based on the geographical distributions of the countries (East, West, Central, and South regions), income categories (low and middle income), and availability of complete data for the period under review. As such, the eventual sample of 26 countries was deemed representative of the 48 economies that make up the SSA region. As a pre-diagnostic check, the data were examined for structural breaks, and we found that there was a structural change in the dataset during the year 2007, the period of the global financial crisis.

Earlier studies used several indicators to measure financial inclusion, categorised into three dimensions: accessibility, availability, and usage. The literature indicates that the application of an individual indicator may lead to partial information and misleading conclusions, hence the proposal of a composite financial inclusion index (Makina and Walle 2019; Jungo et al. 2022; Dabla-Norris et al. 2015). Accordingly, while constructing a composite index to proxy financial inclusion (FI), this study applied the variables reflected in Table 1 below.

Table 1. Financial Inclusion Variables.

Variable	Abbreviation	Dimension Measured
Number of accounts per 1000 adults	NAC	acccessibility
Number of ATMs per 1000 km^2	NAT	availaibility
Number of branches per 1000 km^2	NBR	availability
Geographic spreads of ATMs per 100,000 adults	DAT	availability
Branches of commercial banks per 100,000 adults	BRA	availability
Credit to the private sector as a percentage of GDP	CPS	usage

Source: Authors' own compilation.

Similarly, various economic growth indicators have been used, including GDP growth rate, GDP per capita, and real GDP per capita (Jungo et al. 2022; Evans and Adeoye 2016; Makina and Walle 2019). However, consistent with the research objective, this study applied LnGDP per capita as a proxy for economic growth (EG). In addition, several works indicated that there are various factors that affect the relationship between financial

inclusion and economic growth, and hence this research considered some of these factors as control variables, which include inflation (Inf), financial stability as proxied by Z-Score (FS), technology as a factor of internet expansion (IU), exchange rate (EXR), real interest rate (RIR), and institutional quality (IQI) as the average of the six world governance indicators, namely government effectiveness, regulatory quality, the rule of law, control of corruption, voice and accountability, and political stability (Cooper and Barro 1997; Girma and Shortland 2008; Law and Habibullah 2009; Naceur et al. 2017; Makina and Walle 2019).

3.1. Composite FI Index Development—Principal Component Analysis (PCA)

A principal component analysis (PCA) is used to construct a composite index for financial inclusion to address the multidimensionality of the variable and avoid the possibility of multicollinearity. While developing the composite index, six financial inclusion indicators were selected from its three broad dimensions: accessibility (number of accounts per 1000 adults [NAC]), availability (number of ATMs [NAT] and branches [NBR] per 1000 km^2 and the geographic spreads of ATMs [DAT] and branches of commercial banks [BRA] per 100,000 adults), and usage (credit to the private sector as a percentage of GDP [CPS]) (Demirgüç-Kunt et al. 2017; Dabla-Norris et al. 2015; Makina and Walle 2019; Jima and Makoni 2023). A two-stage approach is used to develop the index, with the data series being first normalised with a min–max approach with the aid of the equation below.

$$F_{i,t} = \frac{K_{i,t} - Min_{i,t}}{Max_{i,t} - Min_{i,t}} \tag{1}$$

where $F_{i,t}$—represents the adjusted indicator i at time t, and $K_{i,t}$ individual FI indicators. $Max_{i,t}$ is the maximum value, and $Min_{i,t}$ is the minimum value of each indicator, respectively.

Secondly, we computed the Eigenvalues for the indicators and developed our composite index. In this case, this study used the equation stated below to construct the composite index to proxy financial inclusion.

$$FI_i = W_{i1}Z_1 + W_{i2}Z_2 + W_{i3}Z_3 + \ldots + W_{in}Z_n \tag{2}$$

where FI_i = estimate of the ith factor of financial inclusion; W_i = weight of the score coefficient; Z_i = individual variables of interest (NAC, NAT, NBR, DAT, BRA, CPS); and n = number of variables.

3.2. Econometric Model Specification

A panel unit root test is used to ascertain the stationarity of the data and avoid possible serial correlation. Subsequently, a panel ARDL cointegration test is employed to assess the short-run and long-run relationship between financial inclusion and economic growth. In addition, a Granger non-causality test is applied to examine the existence of causality and identify its direction. The tests and estimation equations of this study are presented in the next section.

3.2.1. Unit Root and Serial Correlation Tests

In empirical research, it is necessary to avert spurious outcomes. Spurious regression leads to fallacious results when the factors of regression lack constant means and variance (Gujarati 2003). Although panel unit root tests are usually undertaken to assess the stationarity properties of variables in econometrics, it has been found that a dynamic panel data approach is effective regardless of whether the variables under assessment are integrated in order zero, I(0), or order one, I(1), respectively. However, none of the variables should be in the second difference (Pesaran and Smith 1995). In order to undertake the panel unit root tests, this study employed the model specified as follows:

$$\Delta Y_{i,t} = \alpha_i + \delta Y_{i,t-1} + \sum_{j=1}^{n} \rho_i \Delta Y_{i,t-q} + z_t^i \gamma + u_{i,t} \tag{3}$$

where Δ is the first difference factor for country i for $t = 1, \ldots, n$ periods. $H_0 : \delta_i = \delta = 0$ is the panel unit root test null hypothesis for all i, assuming all series are stationary.

3.2.2. Relationship between Financial Inclusion and Economic Growth

A dynamic system panel generalised method of momentum (GMM) is the instrumental-variable technique used to examine the relationship between financial inclusion (FI) and economic growth (EG). In this model, selected macro and micro factors are used to capture and control their influence on the relationship between the two variables. In line with the stated model, the estimation equation is stated as shown below.

$$EG_{i,t} = \alpha + \beta_1 EG_{i,t-1} + \beta_2 FI_{i,t} + \beta_i \sum_{i=1}^{n} X_{i,t} + SB_{i,t} + e_{it} \quad (4)$$

where $EG_{i,t}$ is the dependent variable; EG (lag of economic growth per capita); and FI (PCA-constructed financial inclusion composite index) for country i at time t; β_i is a coefficient; $X_{i,t}$ stands for the various control variables; SB is a dummy variable representing a structural break; e_{it} is the random error term.

3.2.3. Panel ARDL Cointegration Test

A panel ARDL cointegration test is applied to determine the presence of a long-run relationship between the key variables of financial inclusion and economic growth (FI and EG). It uses both lagged and differenced variables and provides information about the nature of the association and the speed of adjustment to equilibrium after every shock. In this model, a dummy variable (SB) is used to capture the impacts of a structural break. Consistent with the nature of the data, this study applied the Mean Group (MG) and Pooled Mean Group (PMG) estimators (Pesaran et al. 1999). Accordingly, the econometric model is specified as follows:

$$\begin{gathered}\Delta EG_{i,t} = \Pi + \Theta_i[EG_{i,t-1} - \lambda_2 FI_{i,t-1} - \lambda_3 SB1_{i,t-1}] + \sum_{j=1}^{p-1} \pi_{ij} \Delta EG_{i,t-j} + \\ \sum_{i=0}^{n-1} \alpha_{il} \Delta FI_{i,t-l} + \sum_{i=0}^{n-1} \partial_{im} \Delta SB1_{i,t-m} + \varnothing_i + e_{it}\end{gathered} \quad (5)$$

where $\Theta_i = -(1 - \alpha_i)$ a speed adjustment coefficient; λ_2 = vector of the long-run relationships; ECT—the error correction term, indicated in [ ]; π_{ij}, α_{il}, and ∂_{im} represent the short-term coefficient; Δ represents the first difference operator; $EG_{i,t}$, is the dependent variable; EG represents economic growth per capita and FI is the PCA-constructed financial inclusion composite index for country i at time t; SB is a dummy variable representing a structural break; e_{it} is the random error term.

3.2.4. Granger Non-Causality Test

A Granger non-causality test assesses the magnitude and direction of causality between financial inclusion and economic growth, respectively. In theory, a Granger non-causality test may yield three possible outcomes: uni-directional, bi-directional, or absence of causality. For the purposes of this study, we ran the below-specified models to check for causality between financial inclusion and economic growth, respectively:

$$FI_{i.t} = \varnothing_i + \sum_{k=1}^{K} \partial_{i,k} FI_{i,t-k} + \sum_{k=1}^{K} \beta_{i,k} EG_{i,t-1} + \varepsilon_{i,t} \quad (6)$$

$$EG_{i.t} = \varnothing_i + \sum_{k=1}^{K} \partial_{i,k} EG_{i,t-k} + \sum_{k=1}^{K} \beta_{i,k} FI_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

where FI and EG are the variables of interest, being financial inclusion and economic growth, respectively; i is the country; k is the number of lags and $t \in [I, T]$; β and ∂ are coefficients; ε_{it} is the random error term.

4. Findings and Discussion

4.1. Summary of the Descriptive Statistics

In order to observe the level of disparity across the data, we summarised the results of descriptive statistical analysis for the variables that are used in this study in Table 2 below.

Table 2. Summary of the descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
NAC	520	291.841	460.565	0.000	2274.504
BRA	520	4.372	4.309	0.025	22.473
NAT	520	8.889	14.761	0.000	72.450
DAT	520	9.342	36.513	0.000	228.571
NBR	520	5.338	18.088	0.005	111.823
CPS	520	22.418	28.610	0.491	160.125
FI	520	0.200	0.234	0.014	0.824
EG	520	2317.993	3403.413	111.927	22,942.583
FS	520	11.137	6.014	2.204	47.341
INF	520	10.630	32.302	−8.975	513.907
RIR	520	5.552	8.969	−60.781	38.976
EXR	520	802.605	1458.876	0.545	9183.876
TEC	520	9.833	13.295	0.006	68.200
IQI	520	−1.416	1.509	−4.680	2.132

Source: Authors' own computations.

Summary of the statistical analysis above shows that there is a slight variation in the level of financial inclusion and economic growth across the selected SSA countries, as indicated by the standard deviations, and hence it is important to assess and examine the relationship between the two variables.

4.2. Financial Inclusion Index

In line with our earlier discussion on the methodological approaches for this paper, we computed the Eigenvalues of the various financial inclusion indicators using the PCA technique, as shown in Table 3.

Table 3. Principal Components Analysis: Eigenvalues.

Principal Component	Eigenvalue	Variance (%)	Cumulative (%)
1	4.477	74.60	74.60
2	1.015	16.90	91.50
3	0.276	4.60	96.10
4	0.135	2.20	98.40
5	0.083	1.40	99.80
6	0.014	0.20	100.00

Source: Authors' own computations.

Table 3 above shows that the first two principal components explain the maximum variance (91.5%), with an eigenvalue above one (1). The rule of thumb is that components with an eigenvalue above one and a variance greater than the average can be taken for estimation. It is thus possible to conclude that the first two principal components are more relevant to developing the composite index for financial inclusion.

Based on the results shown in Table 4 below, the first two components are used to construct the financial inclusion index for the selected SSA countries. Subsequently, the equation below is used to construct the composite financial inclusion index.

$$\begin{aligned} FI = &((0.452 *NAC) + (0.429 *BRA) + (0.383 *NAT) + (0.367 *CPS) + (0.412 *DAT) + (0.400 *NBR)) \\ &+ ((-0.021 *NAC) + (0.032 *BRA) + (0.528 *NAT) + (0.504 *CPS) + (-0.456 *DAT) + (-0.509 *NBR)) \end{aligned} \quad (8)$$

where FI is the financial inclusion index, NAC represents the number of deposit accounts per 100,000 of the population (access), BRA measures the number of branches per 100,000 of the population (access), NAT is the number of ATMs per 100,000 of the adult population (access), CPS measures private domestic credit gauged by GDP (usage), DAT is the number of ATMs per 1000 km^2 (availability), and NBR is the number of branches per 1000 km^2 (availability).

Table 4. Principal component analysis: Eigenvectors (loadings).

Variable	PC-1	PC-2	PC-3	PC-4	PC-5	PC-6
NAC	0.452	−0.021	−0.066	−0.619	−0.639	0.025
BRA	0.429	0.032	−0.682	0.557	−0.170	−0.102
NAT	0.383	0.528	−0.201	−0.360	0.627	0.105
CPS	0.367	0.504	0.637	0.400	−0.211	−0.015
DAT	0.412	−0.456	0.232	−0.043	0.297	−0.692
NBR	0.400	−0.509	0.175	0.122	0.192	0.707

Source: Authors' own computations.

4.3. Panel Unit Root Tests

Our data were tested for the presence of unit roots using the Levin–Lin–Chu (LLC), Im–Pesaran–Shin (IPS), and Breitung and Pesaran's CIPS techniques. The results of the various unit root tests are reflected in Table 5 below. The two-generation panel unit root tests proved that the variables are stationary. However, the regression results showed a mixed order of integration, indicating that the panel ARDL cointegration test is appropriate for this study.

Table 5. Results of the various Unit Root Tests.

Variables	Levin Lin Chu (LLC)		Im Pesaran Shin (IPS)		Breitung		Pesaran (2007) (CIPS)	
	Statistic	Order	Statistic	Order	Statistic	Order	Statistic	Order
FI	−1.370 *	I(0)	−6.465 ***	I(1)	−5.123 ***	I(1)	−3.980 ***	I(1)
L.FI	−3.7161 ***	I(1)	−6.4904 ***	I(1)	−5.092 ***	I(1)	−3.825 ***	I(1)
EG	−7.260 ***	I(0)	−8.195 ***	I(1)	−5.772 ***	I(1)	−4.147 ***	I(0)
FS	−3.8917 ***	I(0)	−5.4304 ***	I(0)	−3.094 ***	I(0)	−5.902 ***	I(0)
INF	−39.133 ***	I(0)	−8.086 ***	I(0)	−1.998 **	I(0)	−7.481 **	I(0)
RIR	−7.118 ***	I(0)	−8.698 ***	I(0)	−3.625 ***	I(0)	−3.427 ***	I(0)
EXR	−8.107 ***	I(1)	−6.733 ***	I(1)	−8.4720 ***	I(1)	−1.656 ***	I(0)
IQI	−2.787 ***	I(0)	−11.204 ***	I(1)	−5.663 ***	I(1)	−4.212 ***	I(1)
TEC	−7.130 ***	I(0)	−8.536 ***	I(0)	−4.541 ***	I(0)	−10.123 ***	I(0)

Source: Authors' own computations; Note: Robust standard errors in parenthesis (***), (**), and (*) indicate the level of significance at 1%, 5%, and 10%, respectively.

4.4. Panel GMM Estimation Results

The panel system GMM estimation results of this study revealed that there is a strong positive relationship between financial inclusion and economic growth. Table 6 below exhibits the econometric analysis results of this study.

Table 6. Panel dynamic GMM estimation results of this study.

Variables	(Economic Growth)	(Economic Growth)
	One-Step System GMM	Two-Step System GMM
L.EG	0.8799 ***	0.8836 ***
	(0.0511)	(0.0585)
FI	0.5080 ***	0.4815 **
	(0.1799)	(0.2314)
FS	−0.0200 **	−0.0221 *
	(0.0090)	(0.0121)
INF	−0.0012 ***	−0.0012 ***
	(0.0002)	(0.0003)
EXR	−0.0000	−0.0000
	(0.0000)	(0.0000)
RIR	−0.0029	−0.0028
	(0.0035)	(0.0035)
TEC	−0.0039 ***	−0.0033 **
	(0.0012)	(0.0013)
IQI	0.0103	0.0195
	(0.0184)	(0.0227)
Constant	1.1042 ***	1.0822 **
	(0.3637)	(0.4097)
Observations	494	494
Number of countries (Instruments)	26	26
AR(1)	0.0168	0.0247
AR(2)	0.191	0.148
Hansen	0.118	0.119
Sargan	0.002	0.012

Source: Authors' own computations. Note: Robust standard errors in parenthesis (***), (**), and (*) indicate the level of significance at 1%, 5%, and 10%, respectively.

On the basis of the econometric analysis results of this study, in addition to financial inclusion, other macro- and microeconomic factors such as financial stability, inflation, and technology play an important role in promoting economic growth in Sub-Saharan African economies. Given the above results, further effort is made below to confirm whether there is a long-run relationship between financial inclusion and economic growth using the ARDL technique.

4.5. Panel ARDL Cointegration Tests

Prior to undertaking the cointegration tests, this study assessed the optimal lag lengths of the panel and the variables. Using the unrestricted error correction model (UECM) and information criterion, the optimal lag lengths of the variables and the models are (EG (1) and FI (0)), i.e., (1, 0). Subsequently, a panel ARDL cointegration test was conducted using the Mean Group (MG) and the Pooled Mean Group (PMG) estimators, and the Hausman test was applied to select between the two estimators. The overall results of the tests revealed the existence of long-run cointegration with slight variation across the outputs of the estimators. Table 7 below shows the regression results for the two estimators.

Table 7. Panel ARDL estimation results of the two variables (EG and FI).

Dependent Variable (EG)	Mean Group (MG)	Pooled Mean Group (PMG)	Mean Group (MG)	Pooled Mean Group (PMG)
Short Run				
ETC	−0.1278 *** (0.0545)	−0.3384 *** (0.0062)	−0.1299 *** (0.0500)	−0.3690 ** (0.0249)
ΔFI	−1.4777 (1.1217)	−0.5336 (1.4052)	−2.8375 ** (1.2732)	−2.7102 *** (0.0059)
ΔSB1	-	-	−0.1220 *** (0.0243)	−0.0388 ** (0.0196)
Constant	0.9380 (0.2906)	0.3822 *** (0.0536)	−0.9561 ** (0.2672)	−0.2990 *** (0.1335)
Long Run				
FI	3.6487 (4.4996)	4.1785 *** (3.8686)	2.4441 (4.8391)	4.2693 *** (1.4554)
SB1	-	-	0.2021 (1.5236)	1.3072 (0.3385)
Number of Obs			494	494
Number of Groups			26	26
Hausman (Prob > ch2)	Inconclusive		0.211	

Source: Authors' own computations; Note: Robust standard errors in parenthesis (***), (**), and (*) indicate the level of significance at 1%, 5%, and 10%, respectively.

Table 7 above also shows that the Hausman test, which helps to determine whether there is a significant difference between MG and PMG estimators, confirmed that the PMG is more efficient and consistent compared to the MG (Hausman 1978). The output of the pooled mean group (PMG) estimator indicates long-run cointegration between the variables at the 5% level of significance. In addition, the error correction term and the short- and long-run coefficients are significant at 5%, indicative of a strong cointegration between financial inclusion and economic growth, and any deviation from equilibrium is corrected at an adjustment speed of around 37%.

Moreover, regardless of the estimators applied, financial inclusion has a significant negative influence on economic growth in the short run. This result is consistent with other scholars who found a significant negative relationship between these variables in the short run (Seven and Yetkiner 2016; Law and Singh 2014; Gourène and Mendy 2017; Collins and Ng'weno 2018; van Wyk and Kapingura 2021). Law and Singh (2014) and Gourène and Mendy (2017) argued that one of the reasons for the short-run negative relationship may be due to the high inequality in the regions, the low level of domestic saving, and a high dependency on foreign capital sources. A low level of financial inclusion and a high concentration of per capita income among a small group of people may expose the financial sector to more economic crises rather than growth. Although financial services have expanded over the past years, there is no clear evidence that shows financial access has improved the lives and per capita income of the masses (Collins and Ng'weno 2018). Instead, it raises the wealth of a few rich individuals, who spend their funds in the short run. In addition, the expansion of bank accounts did not have a significant effect on savings, as it is difficult to predict how households would use their income (Dupas et al. 2018; Kim et al. 2018).

Also, in Table 7 above, the application of a dummy variable to capture a structural break during the period under assessment had no significant impact on the relationship between the two variables in the long run. However, the structural change did exert an impact in the short run, indicating that the global financial crisis of 2007–2008 negatively

affected economic growth in the short run. In addition, the structural change brought a slight difference in the magnitude of the coefficients, which shows that any structural change in the economy will have its own implications on the relationship between the financial system and economic growth.

On the other hand, this study revealed a significant positive long-run relationship between financial inclusion and economic growth. This indicates that inclusive finance for the marginalised population and economic growth move together, which is consistent with the findings of other scholars (Kim et al. 2018; Ali and Khan 2020; Fanta and Makina 2019). On the basis of the above findings, it is possible to conclude that financial inclusion will raise individual participation in the economy and thereby economic growth in the SSA countries. It is, therefore, critical for policymakers and regulators to develop and introduce proper strategies, policies, and regulations that enhance and promote financial inclusion in the region. In order to identify the direction of causality, it is appropriate to conduct a Granger non-causality test.

4.6. Panel Granger Non-Causality Tests

Once the existence of a long-run relationship is ascertained between financial inclusion (FI) and economic growth (EG), it is logical to assess the causalities between FI and EG and identify the directions of causality. Accordingly, the results of the Granger non-causality tests show that there is a causal relationship between financial inclusion and economic growth. A summary of the Granger non-causality tests is presented in Table 8 below.

Table 8. Granger causality test results (EG and FI).

Variable Y	Causality Directions	Variable X	Juodis et al. (2021)	Dumitrescu and Hurlin (2012)
	←		Wald Test	Z-Bar
EG		FI	40.369 ***	40.571 ***
FI		EG	10.137 ***	4.798 ***

Source: Authors' own computations; Note: Robust standard errors in parenthesis (***), (**), and (*) indicate the level of significance at 1%, 5%, and 10%, respectively.

Wald statistic (Juodis et al. 2021) and Z-bar statistic (Dumitrescu and Hurlin 2012) causality analysis results above indicated that financial inclusion Granger causes economic growth at a 5% level of significance, indicating the existence of causality that runs from financial inclusion to economic growth. In the same manner, the null hypothesis that economic growth does not (Granger) cause financial inclusion is rejected at a 5% level of significance, indicating the existence of causality that runs from financial inclusion to economic growth, implying complementarity. Lewis (1955) was the first to recognise the existence of a bi-directional causality between financial inclusion and economic growth. Several other studies also suggested this type of retroactivity and supported the argument of a two-way assertion (Sharma 2016; Okpara et al. 2018; Nayak and Yingnan 2019). On the basis of the above findings, it is logical to argue that the SSA countries should follow a holistic approach and adopt policies and strategies that promote synergy and, thereby, sustainable economic growth in the region.

5. Conclusions and Recommendations

Based on the overall results of this paper as derived from the panel ARDL cointegration and the Granger non-causality tests, we found that there is a positive and significant long-run relationship between financial inclusion and economic growth. We also conclude that there is bi-directional causality between financial inclusion and economic growth, indicating synergy and complementarity, similar to the work of Chima et al. (2021). This implies that financial services expansion enhances economic performance and contributes towards achieving sustainable economic growth and development in the SSA countries. Likewise, the growing needs of the productive sectors of the economy push up the demand for access

to financial services. It is, therefore, important to expand the availability, accessibility, and affordability of formal financial products and services to all citizens of a country, regardless of their economic standing, so as to realise the UN sustainable development goals and the AU 2063 agenda in the region on financial inclusion and economic growth.

One of the limitations of this study is that it generalised the relationship between financial inclusion and economic growth across the SSA region. However, it is also possible to observe the relationship between the two variables within individual country contexts since levels of economic and financial development vary. As such, we suggest that future studies consider undertaking comparative analysis to determine what the effect of other individual factors on financial inclusion and economic growth may be. In addition, our paper only addressed one facet of the macroeconomic puzzle, and in the future, it will be important to acknowledge the role of financial inclusion in income inequality and economic growth across the region.

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