Innovations

Effect of Financial Inclusion and Financial Development on Income Inequality in Sub-Sahara African Countries

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Abstract: *This study investigates the dynamic relationship between financial inclusion, financial development, and income inequality in Sub-Saharan African countries. The research examines the short and long term impacts of financial inclusion in terms of accessibility, availability, and usage, on income inequality. The study applies a panel autoregressive distributed lag (PARDL) model to data from the period 2000 to 2023, and identifies key drivers of inequality reduction and their underlying mechanisms. The results show that financial development and availability of financial services significantly reduce income inequality in the long run, whereas the effects of accessibility and usage are contingent on the context. The stability of this long term equilibrium is indicated by the error correction term, which adjusts deviations at an annual rate of 83%. Reducing illiteracy and increasing availability of financial services in the short term have immediate inequality reducing effects, but sustained efforts are needed to produce broader impacts. In addition, the study shows bidirectional causality between financial inclusion measures and income inequality, suggesting that they are not independent. The results indicate that to achieve equitable economic growth in developing economies, financial access must be integrated with policies that improve financial literacy and address structural barriers.*

Keywords *Financial Inclusion, Financial Development, Income Inequality, Sub-Sahara African Countries, a panel autoregressive distributed lag*

JEL Classification: G20, G21, G33

1. Introduction

Financial inclusion and financial development are key concepts in the economic growth and development discourse, especially in low and middle income countries (LMICs). Financial inclusion is the access to essential financial services like credit, savings, and insurance by individuals and businesses (regardless of socio economic status and geographic location) (Demirgüç-Kunt Klapper & Singer, 2018). On the

other hand, financial development concentrates on the improvement of financial markets and institutions, which should be productive in mobilizing resources and promoting growth with equity (Beck, Demirgüç-Kunt & Levine, 2007). Financial liberalization involves opening of financial markets whereas financial development aims at improving the quality of those markets that can eventually decrease income inequality.

According to empirical evidence, financial inclusion can increase income equality by providing underserved populations with enhanced access to economic opportunities (Öndes & Kızılgöl, 2024). According to the World Bank's Global Findex Database (2021), some 1.4 billion adults are unbanked, with the vast majority living in LMICs. World Bank (2021) estimates that 54.9% of the population in Sub-Saharan Africa and 41.5% in South Asia still lack access to a financial account. Because of this exclusion, people cannot participate economically; people and small businesses cannot get credit, save, or be insured against financial risks, which hampers individual and national economic growth.

The significance of financial inclusion in fostering economic development and alleviating poverty is becoming increasingly apparent. Financial inclusion, by enhancing access to financial services, can elevate income, particularly for the lowest 40 percent of the population, and contribute to an increase in GDP per capita (IMF, 2022). Multiple research indicate a favourable relationship between financial inclusion and the diminishment of economic disparity. Orekoya and Akintunde (2023) contend that financial inclusion is a crucial remedy for income inequality in Nigeria, however Chisadza and Biyase (2023) assert that it serves to diminish the disparity between emerging and developed economies.

Sustaining economic equality is equally important, and it requires the emergence of efficient financial markets and institutions. On one hand, efficient markets promote equitable growth in a developed economy, but on the other hand, underdeveloped markets in many developing countries result to persistent income inequality (Jima & Makoni, 2023). Therefore, financial development (deepening of markets, widening of access to services, and improving institutional efficiency) is not only necessary for economic growth but also for equitable distribution of income (Beydokhti et al., 2023). Moreover, recent research is elucidating the intricate dynamics of the links among financial inclusion, financial development, and income inequality. Chinoda and Mashamba (2021) contend that financial technology (fintech) can enhance financial inclusion and reduce economic inequality in Africa. Adeneye, Farooq, and Rasheed (2024) discovered that country-specific characteristics, such as the level of financial development, influence the link between financial development and income inequality.This study aims to explore the long- and short-term dynamics

between financial inclusion, financial development, and income inequality, providing new insights into their interplay in developing countries

2. Literature Review

This study is based on the Financial Intermediation Theory, which provides a robust framework for understanding the relationship between financial inclusion, financial development, and income inequality. Proposed by Scholtens and van Wensveen (2003), the theory highlights the critical role of financial intermediaries, such as banks and credit unions, in reducing transaction costs, managing risks, and increasing liquidity. These functions are essential for enhancing economic activity, particularly in developing economies where significant portions of the population lack access to financial systems. This theory has relevance because it explains how financial intermediaries can deal with structural barriers that lead to income inequality. Intermediaries give marginalized groups access to credit, savings and other financial services that can be invested in education, healthcare, and entrepreneurial activities, thereby increasing their income generating capabilities. Narrowing income disparities through extending access to economic resources and opportunities, inclusive financial systems. According to Beck et al. (2008), in regions such as Sub-Saharan Africa where financial exclusion is widespread, these mechanisms are crucial for reducing inequality and promoting inclusive development.

Financial intermediation is closely tied to financial development, which is also shown to play a complementary role in determining income distribution. Financial systems that work well allocate resources efficiently, facilitate access to finance and enable low income groups to engage in economic activities. Levine (2005) found that inclusive financial networks promote economic growth by reducing information asymmetries and widening access to financial services. It shows that financial development plays a critical role in tackling income inequality and sustaining equitable growth in developing economies. There has been a growing interest in the relationship between financial inclusion, financial development and income inequality in economic research. The access to affordable and effective financial services, or financial inclusion, is necessary to reduce poverty and eliminate income gaps (Demirgüç-Kunt et al., 2017). It is now well documented that inclusive financial systems can empower disadvantaged groups by improving access to credit, savings, and insurance and thereby enabling investments in education, health, and entrepreneurship (Beck et al., 2008). However, in Sub-Saharan Africa, financial exclusion continues to be formal financial institutions underserve a persistent problem as the population.

Financial development improves financial systems' efficiency and increases economic opportunities and, hence, mitigates income inequality, according to

empirical evidence. For example, Levine (2005) posits that financial development facilitates resource allocation and fosters economic growth. For instance, Allen et al. (2016) also point out that financial development diminishes income disparities, which is brought about by a wider financial access. Though, systems that are poorly regulated can actually increase inequality by disproportionately benefiting wealthier groups (Beck et al., 2007). Financial development without policy that ensures inclusivity will not lead to equitable outcomes. Research also supports the link between financial inclusion and income inequality. For instance, Sharma (2016) found that greater financial access reduces income disparities by enabling low-income households to smooth consumption and invest in productive activities. Nguyen (2021) emphasize that financial inclusion policies should be coupled with strong regulatory frameworks to ensure equitable access and sustainable outcomes. Despite these findings, significant gaps remain in understanding the long-term dynamics of financial inclusion and its interaction with financial development in addressing inequality, particularly in Sub-Saharan Africa.

Chinoda and Mashamba (2021) proposed the "double FFI Model" to analyse the relationships between financial technology, financial inclusion, income inequality, and financial development using Structural Equation Modelling on 25 African countries from 2011 to 2017. Financial technology serves as a mediating factor that influences the relationship between financial inclusion and income, and exhibits potential for reducing income disparity. Azimi (2022) examined South Asian economies from 2004 to 2020 using dynamic panel models that integrated both a financial inclusion index and macroeconomic control variables. The analysis revealed that financial inclusion exhibits enduring co-integrated linkages with poverty and income inequality, while also serving as an effective instrument for poverty alleviation. The study identified institutional quality, mobile penetration, and education as critical factors influencing the impact of financial inclusion on its objectives.

Using principal component analysis and two stage least square (2SLS), Pham, Nguyen, and Ngo (2022) analyzed the impact of financial inclusion on income inequality in 29 European high and upper middle income countries (2011–2017). The study found that financial inclusion plays a major role in reducing inequality, and that education and economic openness enhance this effect. Furthermore, Orekoya and Akintunde (2023) examined the effect of financial inclusion on income inequality in Nigeria within the period 1981–2021, using ARDL models. The results showed that in the short run, financial stability negatively but insignificantly impacts inequality and financial depth positively and significantly. In the long run, financial access and economic growth strongly aggravate inequality, which should increase the focus on

policies aimed at extending financial services to underserved populations. Beydokhti, Esmaeilpour, and Razmi (2023) using panel data models assessed the role of financial inclusion in income inequality in 18 developing countries (2005–2019). The results show that access and use of financial services significantly reduce inequality. Inflation is interestingly, a mitigating factor, whereas GDP growth, trade openness and unemployment are exacerbating factors. Jima and Makoni (2023) investigated the role that financial inclusion plays in achieving financial stability and economic growth in 26 Sub Saharan African economies. Using principal component analysis and ARDL co integration tests, they find evidence of short and long run co integration between financial inclusion, sound financial systems and economic development. Their Granger causality analysis indicated bi-directional and uni-directional causal relationships among these factors as they are interdependent. Likewise, Nantharath and Kang (2023) also used PMG–ARDL model to examine the relationship among the financial inclusion indicators—bank branches, account ownership, and ATMs with GDP per capita in seven ASEAN countries (2000–2021). The researchers found a positive long run relationship with bank branches and account ownership positively related to GDP growth (0.57% and 1.03%, respectively, for a 1% increase in bank branches and account ownership). Yet, the effect of ATMs was less significant, implying a heterogeneous effect on inclusion dimensions.

Furthermore, The effects of financial inclusion on income inequality in Asia was examined using FMOLS and ARDL by Verma and Giri (2024). They find that in the long run, income inequality is responsive to financial inclusion variables, including the number of bank branches and depositors. While the short run effects were not significant, this implies that there was a lagged effect of financial inclusion to inequality. Badeeb, Philip, and Wong (2023) studied the role of financial inclusion and innovation in poverty and inequality reduction in some selected ASEAN countries. Nevertheless, we find that financial inclusion decreased inequality, whereas financial innovation favored better off groups and increased inequality. This work shows that the low income population is in need for financial innovations. Similarly, In 21 Asian countries between 2004 and 2019, Chisadza and Biyase (2023) investigate the nexus between financial inclusion and economic growth. This is reflected in their findings, which show a clearly positive long term effect of financial inclusion on economic growth but also bidirectional causality. Analysis of sub-samples also indicates that the effects of financial inclusion are much stronger in developing economies than in developed ones, highlighting the importance of financial inclusion in generating equitable growth in resource constrained economies. In addition, Jain and Mohapatra (2024) examine the dynamic interplay between trade, economic growth, poverty and income inequality (GIP triangle) in 18

emerging markets between 1991 and 2020 using a panel ARDL framework. We find that trade promotes economic growth and reduces income inequality, but has little effect on poverty reduction. It underlines the fact that their efficiency depends on the harmonization of trade policies and complementary trade reforms.

Also, Rasheed, Adeneye and Farooq (2024) examine how financial inclusion moderates the relationship between income inequality and carbon emissions in 17 Asian countries over the period 2011 to 2022. The study uses panel fixed effects, quantile regressions and 2SLS methods to find that income inequality leads to higher carbon emissions and financial inclusion acts as a partial mitigator. But, mediating effects on digital financial inclusion are weaker, as low income populations have differential access to digital technologies. These results highlight the environmental importance of income inequality, as well as the role of inclusive financial innovations. In Wong, Badeeb, and Philip (2023), financial inclusion's impact on poverty and income inequality in the selected ASEAN countries is assessed, with financial innovation playing a moderating role. Financial inclusion reduces inequality, but financial innovation widens inequality, as financial innovations disproportionately favor the higher income groups. The results highlight the imperative of sustainable and inclusive financial innovations that serve low income populations. Using PMG-ARDL models, Nantharath and Kang (2023) examine the relationship between financial inclusion and economic growth across seven ASEAN countries from 2000 to 2021. Indicators of financial inclusion, including the proportion of account holders and the density of bank branches, exhibit a notable positive long-term correlation with GDP growth. Nonetheless, the short-term effects exhibit greater volatility; therefore, sustained financial inclusion efforts are essential for achieving long-term growth.

Financial inclusion and its effect on income inequality have been well studied. The literature, however, mainly focuses on emerging and developed countries, with the exception of Sub-Saharan Africa (SSA), where personal access to financial services is relatively low (Azam, 2024; Onatunji, 2024). Additionally, despite financial inclusion being measured in terms of accessibility, availability, and usage there is no consensus on which measurement dimension best captures the complex nature of financial inclusion (Jima & Makoni, 2023; Chinoda & Mashamba, 2021). However, this inconsistency impedes a clear picture of the phenomenon across regions. Additionally, previous studies mainly focus on the impacts of financial inclusion, financial development and income inequality separately, but not in combination (Wong et al., 2023; Rasheed et al., 2024). In addition, comparisons are complicated and the robustness of findings is questioned because diverse statistical methodologies are applied across studies (Azimi, 2022; Verma & Giri, 2024). In light

of these gaps, this study fills this gap by focusing on SSA and using a new composite index of financial inclusion that considers not one but multiple dimensions (accessibility, availability, and usage). Moreover, it jointly models financial development and financial inclusion using an Autoregressive Distributed Lag (ARDL) framework that permits both short and long runs analysis.

3. Materials and Methods

This study adopts an ex post facto research design, which is suitable for analyzing the relationship between financial inclusion, financial development, and income inequality using historical data. We chose the ex post facto design to observe preexisting conditions or events without altering them, particularly in the context of financial inclusion and development. We understand the causal relationships among these variables without direct experimental manipulation (Kerlinger & Lee, 2000). The ex post facto design, given the non-experimental nature of the variables, allows the identification of patterns and drawing conclusions about the long-term effects of financial inclusion and development on income inequality.

The population for this study is the Sub-Saharan African countries excluding South Asian, Latin American, and Southeast Asian countries. According to the World Bank (2023), there are 48 countries in Sub Saharan Africa. To determine an appropriate sample size, Taro Yamane's formula for sample size calculation was used which gives a sample size of approximately 43 countries. This sample size ensures that the results are representative of Sub-Saharan Africa, considering data availability for the relevant period (2000-2023). The selection of 43 countries was driven by the need for complete and reliable data covering the study period (2000–2023). Data completeness is critical to ensure the validity and reliability of the analysis, as countries with significant gaps or inconsistencies in key variables—such as financial inclusion indicators, financial development metrics, and income inequality measures were excluded. This approach guarantees that the findings accurately reflect the dynamics of financial inclusion and development in Sub-Saharan Africa. Additionally, prioritizing countries with accessible and comparable datasets addresses challenges related to inconsistent reporting and enhances the study's robustness and credibility.

3.1 Model Specification

Following Azimi's (2022) work, which utilized a dynamic panel model to examine the long-run co-integrated relationships between financial inclusion, poverty, and income inequality while incorporating several macroeconomic control variables, this study adapts and extends the approach. By including a broader set of variables and incorporating financial development alongside financial inclusion, the model offers a more comprehensive analysis.

The functional relationship between income inequality (GINI), financial inclusion (FININC), financial development (FINDEV), and control variables can be expressed as follows:

GINI=F(FDV,FAC, FAV,FUS, ADR,HC,GPC,HCM)

The model can be formally specified in the following Panel ARDL equation:

$GINI_{it}=\beta_0+\beta_1 GINI_{it-1}+\beta_2 FDV_{it}+\beta_3 FAC_{it}+\beta_4 FAV_{it}+\beta_5 FUS_{it}+\beta_4 6ADR_{it}+\beta_7 HC_{it}+\beta_8 GPC_{it}$
$+\beta_9 HCM_{it}+\beta_{10} ECM(-1)_{it}+\epsilon it$

Where:

GINI is the income inequality measure (Gini coefficient) for country i at time t,
FAC= Financial service accessibility
FAV= Financial service availability
FUS= Usage of financial services,
FDV = Financial development
ADR = Adult illiteracy rate,
HC = Human capital,
GPC = GDP per capita,
HCM = Household consumption.
$\beta_0$is the constant term,
β1 –β10 are the coefficients to be estimated,
ϵit is the error term.

This model allows for the estimation of both short-term and long-term relationships, providing insights into how financial inclusion and financial development, alongside relevant control variables, influence income inequality across countries.

3.2 Variable Description and Measurement

The table below provides an overview of the variables, their proxies, and sources.

Table 1: Variable Description and Measurement

Variable	Dimension	Proxy	Source
Income Inequality	-	Gini coefficient	World Bank WDI
Financial Inclusion	Accessibility	Number of bank branches per 100,000 adults	World Bank Findex
	Availability	ATMs per 100,000 adults	World Bank Findex
	Usage	Account ownership (% age 15+)	Global Findex Database
Financial Development	-	Domestic credit to private sector (% of GDP)	World Bank WDI
Control	Human Capital	Education expenditure (%	World Bank

Variables		of GDP)	WDI
	Literacy Level	Adult literacy rate	UNESCO
	Per Capita Income	GDP per capita (constant 2010 US$)	World Bank WDI
	Household Consumption	Household final consumption expenditure (% of GDP)	World Bank WDI

Source: Author's computation

3.3 Estimation Technique

The analysis commences with the examination of unit roots by panel unit root tests (Levin, Lin, & Chu, 2002; Im, Pesaran, & Shin, 2003) to ascertain that the variables are stationary or integrated of order 0 or 1. The subsequent phase involves employing the boundaries testing methodology for cointegration (Pesaran et al., 2001), enabling the examination of long-term correlations among the variables. Upon confirming cointegration, the Panel ARDL model was employed to estimate the short- and long-term links among financial inclusion, financial development, and income inequality. An error correction term (ECT) will be incorporated to evaluate the rate at which discrepancies from the long-term equilibrium are rectified. The study will utilise the Granger causality test to investigate the causative linkages among the variables, determining if financial inclusion or financial development can predict income inequality, or the reverse. This test offers essential insights into the dynamics of the interactions between the major variables.

3.4 A Priori Expectations

It is expected that financial inclusion (as measured by the average of the three proxies: accessibility, availability, and usage) will lead to a reduction in income inequality, as access to financial services is likely to improve economic opportunities for previously underserved populations. Similarly, financial development, reflected by domestic credit to the private sector, is anticipated to reduce income inequality, provided that financial systems are inclusive and reach a broad section of society. Control variables such as human capital, literacy rate, per capita income, and household consumption are also expected to have a mitigating effect on income inequality, as higher levels of education and income typically lead to greater economic mobility and a more equal distribution of resources across society.

4. Result and analysis

4.1 Descriptive Statistics

Table 2: Summary of Descriptive Statistic

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	obs
GINI	37.739	37.969	49.993	25.006	7.161	1032
FDV	44.463	44.081	79.969	10.001	19.983	1032
FAC	10.295	10.102	19.988	1.008	5.582	1032
FAV	27.034	26.954	49.884	5.001	12.964	1032
FUS	50.243	50.992	79.968	20.008	16.860	1032
ADR	72.524	72.167	94.974	50.027	12.828	1032
GPC	5154.106	5192.103	9973.232	500.502	2747.641	1032
HC	5.862	5.804	9.981	2.002	2.294	1032
HCM	64.528	63.801	89.960	40.033	14.756	1032

Source: Author's computation

The GINI index, a measure of income inequality, has a mean value of 37.739 with a standard deviation of 7.161, indicating moderate income disparities across the sample. The observed range, with a minimum value of 25.006 and a maximum of 49.993, reflects significant differences in inequality levels among the countries analyzed. Among the components of financial inclusion, Accessibility (FAC) exhibits a mean of 10.295 and relatively low variability, as indicated by a standard deviation of 5.582. Availability (FAV), on the other hand, has a mean of 27.034 and a higher standard deviation of 12.964, suggesting greater disparities in the availability of financial services infrastructure. Usage (FUS), with a mean of 50.243 and a standard deviation of 16.860, indicates that while the utilization of financial services is relatively high on average, there are substantial variations across the sample. Financial Development (FDV) has a mean of 44.463 and a standard deviation of 19.983, reflecting considerable variation in the depth of financial markets and institutions among the countries. Similarly, GDP per capita (GPC) shows the widest range, with a mean of 5,154.106 and a standard deviation of 2,747.641, indicating significant economic differences across the sample. Other variables, such as Household Consumption (HCM) and Human Capital (HC), show more moderate levels of variability. HCM has a mean of 64.528 and a standard deviation of 14.756, with values ranging from 40.033 to 89.960, while HC has a mean of 5.862 and a standard deviation of 2.294, showing relatively stable levels of human capital across the sample.

4.2 Unit Root Test

Table 3: **Panel Unit Root Test Results**

Variable	**Test at Levels**		**Test at 1st Difference**	
	Levin, Lin & Chu t*	**Im, Pesaran and Shin**	**Levin, Lin & Chu t***	**Im, Pesaran and Shin**
	Prob.	**Prob.**	**Prob.**	**Prob.**
GINI	-10.248	-12.722	-18.635	-26.681
	0.000	0.000	0.000	0.000
ADR	-1.842	-4.908	-17.614	-26.537
	0.089	0.348	0.000	0.000
FAC	-1.841	-1.876	-18.722	-25.864
	0.431	0.343	0.000	0.000
FAV	-12.600	-13.946	-20.242	-27.031
	0.000	0.000	0.000	0.000
FDV	-8.808	-12.598	-19.709	-27.741
	0.000	0.000	0.000	0.000
FUS	-11.193	-14.180	-21.292	-27.593
	0.000	0.000	0.000	0.000
GPC	-9.138	-13.122	-18.098	-27.735
	0.000	0.000	0.000	0.000
HC	-12.190	-14.571	-17.569	-26.674
	0.000	0.000	0.000	0.000
HCM	-12.350	-15.447	-15.447	-26.674
	0.000	0.000	0.000	0.000

Source: Author's computation

The panel unit root test results presented in Table 3 indicate a mix of stationarity levels across the variables, providing crucial justification for the use of the ARDL (Autoregressive Distributed Lag) framework. Specifically, the results from the Levin, Lin & Chu (LLC) and Im, Pesaran, and Shin (IPS) tests show that some variables, such as GINI and FAV, are stationary at levels (I(0)), as their p-values are statistically significant at the 5% level. Other variables, including ADR, AFI, FAC, FDV, and GPC, are non-stationary at levels but become stationary after first differencing (I(1)), evidenced by their significant p-values at the first difference. It is important to note that variables such as FAV and FDV exhibit mixed stationarity properties (I(0) and I(1)), meaning they exhibit stationarity at both levels and first differences in certain test specifications. We adopt a panel ARDL model, robust to mixed orders of variable integration, to conduct valid long-run and short-run estimations, given the combination of I(0) and I(1) variables involved. Furthermore, we choose the ARDL

methodology due to its ability to model dynamic relationships and accommodate cross-sectional heterogeneity in the panel data.

4.3Panel ARDL Test

Table 4: Panel ARDL Long-Run and Short-Run Results

Variable	Coefficient	Std. Error	t-Statistic	p-value
Long-Run Equation				
FDV	-0.044	0.017	-2.568	0.010
FAC	0.178	0.055	3.207	0.001
FAV	-0.060	0.026	-2.287	0.015
FUS	0.045	0.019	2.323	0.007
ADR	-0.066	0.025	-2.581	0.005
GPC	-0.064	0.030	-2.118	0.032
HC	-0.060	0.148	-0.402	0.688
HCM	0.136	0.525	0.259	0.796
Short-Run Equation (ECM Regression)				
ECM(-1)	-0.829	0.041	-20.066	0.000
D(FDV)	0.024	0.012	2.026	0.043
D(FAC)	0.088	0.043	2.061	0.042
D(FAV)	-0.045	0.022	-2.063	0.043
D(FUS)	0.029	0.013	2.150	0.030
D(ADR)	-0.039	0.017	-2.288	0.026
D(GPC)	-0.498	0.410	-1.216	0.225
D(HC)	-0.015	0.118	-0.130	0.897
D(HCM)	-0.003	0.017	-0.170	0.865
Constant (C)	34.614	1.756	19.712	0.000
Model Diagnostics				
R-squared	0.653			
Adjusted R-squared	0.603			
Durbin-Watson stat	2.009			
Wald Test (Short-Run Dynamics)	6.888			0.067
Pesaran Cross-Section Dependence Test	8.784			0.453

Source: Author's computation

Table 4 presents the findings from the Panel ARDL analysis which explains both short-term and long-term associations between financial inclusion and its relationship with financial development and income inequality. The long-run relationship between variables exists because the error correction term (ECM) has a

negative value of -0.829 which demonstrates statistical significance at the 0.001 level. The adjustment process toward long-run equilibrium occurs at an annual rate of approximately 83% indicating robust adjustment dynamics.

In the long-run estimates, financial development (FDV) negatively impacts income inequality (GINI) with a coefficient of -0.044 ($p = 0.010$), implying that greater financial depth contributes to reducing inequality. Similarly, financial inclusion availability (FAV) also exhibits a significant negative relationship (coefficient = -0.060, $p = 0.015$), further underscoring the role of accessible financial services in mitigating inequality. On the other hand, financial inclusion usage (FUS) and financial inclusion accessibility (FAC) have positive long-run coefficients (0.045 and 0.178, respectively), suggesting that increased usage and access to financial services improve financial participation, though FAC's influence is larger in magnitude. Furthermore, adult illiteracy rate (ADR) and GDP per capita (GPC) show significant negative long-run coefficients, highlighting that reductions in illiteracy and economic development also play crucial roles in lessening inequality. However, human capital (HC) and household consumption (HCM) are statistically insignificant in the long run ($p > 0.05$), suggesting that their effects on income inequality may be less pronounced.

In the short-run equation, most differenced variables, such as D(FDV), D(FAC), D(FAV), and D(FUS), demonstrate significant effects on income inequality, with p-values below 0.05. Notably, the short-run impact of D(ADR) is also significant, with a coefficient of -0.039 ($p = 0.026$), indicating that reducing illiteracy can have immediate inequality-reducing effects. However, variables such as D(GPC), D(HC), and D(HCM) are insignificant in the short-run dynamics ($p > 0.05$), highlighting the temporal nature of their effects.

The model diagnostics indicate strong goodness-of-fit, with an R-squared of 0.653 and an adjusted R-squared of 0.603, suggesting that the independent variables collectively explain approximately 60% of the variation in income inequality. The Durbin-Watson statistic of 2.009 indicates no evidence of serial correlation in the residuals. Additionally, the Wald Test for short-run dynamics ($p = 0.067$) and the Pesaran Cross-Section Dependence Test ($p = 0.453$) confirm the robustness of the model.

The findings emphasise the essential role of financial inclusion and development in mitigating income inequality, especially via long-term mechanisms. The findings highlight the significance of policies aimed at improving financial access, availability, and utilisation, alongside initiatives to decrease illiteracy and promote economic development. These measures collectively enhance the equitable distribution of resources and economic opportunities.

4.4 Causality test

Table 5: Pairwise Dumitrescu-Hurlin Panel Causality Tests Results

Null Hypothesis	W-Statistic	p-value	Inference
FAC does not homogeneously cause GINI	2.709	0.028	FAC → GINI
GINI does not homogeneously cause FAC	2.476	0.006	GINI → FAC
FAV does not homogeneously cause GINI	2.042	0.039	FAV → GINI
GINI does not homogeneously cause FAV	2.943	0.012	GINI → FAV
FUS does not homogeneously cause GINI	3.897	0.004	FUS → GINI
GINI does not homogeneously cause FUS	1.951	0.424	No causality detected
FDV does not homogeneously cause GINI	2.098	0.039	FDV → GINI
GINI does not homogeneously cause FDV	2.884	0.024	GINI → FDV

Source: Author's computation

In Table 5, the results of the Pairwise Dumitrescu-Hurlin Panel Causality Tests show that there are significant causal relationships between financial inclusion, financial development and income inequality (GINI). The results show bidirectional causality between several of the variables, indicating that these constructs are mutually dependent and dynamically interact with one another.

For financial inclusion accessibility (FAC) and income inequality, the p-values of both "FAC does not homogeneously causes GINI" (p = 0.028) and "GINI does not homogeneously causes FAC" (p = 0.006), are both significant and suggest bidirectional causality. Hence, accessibility to financial services reduces income inequality and changes in inequality levels affect the accessibility of financial infrastructure.

Likewise, we show that financial inclusion availability (FAV) has bidirectional causality with GINI, with significant p-values for "FAV does not homogeneously cause GINI" (p = 0.039) and "GINI does not homogeneously cause FAV" (p = 0.012). The finding underscores the bidirectional relationship between the provision of financial services and its potential to reduce inequality on the one hand, and the influence of income distribution on the provision of financial infrastructure on the other hand. The test verifies a unidirectional causality from FUS to GINI (p = 0.004),

supporting that greater use of financial services substantially reduces income inequality.. However, no evidence of reverse causality is found, as "GINI does not homogeneously cause FUS" is statistically insignificant (p = 0.424).
The results for financial development (FDV) also indicate bidirectional causality with GINI. Both "FDV does not homogeneously cause GINI" (p = 0.039) and "GINI does not homogeneously cause FDV" (p = 0.024) are statistically significant, suggesting that financial sector depth plays a critical role in reducing inequality, and vice versa, where disparities in income distribution can influence financial development.

4.5 Discussion of Findings

The results of this study indicate that financial inclusion, financial development, and other economic variables play a significant role in explaining income inequality as shown in panel ARDL results and Dumitrescu – Hurlin panel causality tests. In the long run, financial development (FDV) and financial inclusion availability (FAV) significantly reduce income inequality as predicted by Financial Intermediation Theory and Access to Finance Theory. According to these theories, financial development and access facilitate the reduction of transactional barriers and offer marginalized groups the opportunity to participate in economic activities, thus mitigating income disparities (Beck et al., 2008; Demirgüç-Kunt et al., 2017). On the other hand, the positive long run coefficients for financial inclusion accessibility (FAC) and financial inclusion usage (FUS) indicate that wider accessibility and usage of financial services lead to increased participation in financial markets, but their benefits may not be evenly distributed, and may even further widen inequality in some cases. This aligns with the findings of Wong et al. (2023), which also found that financial innovations that help the rich exacerbate inequality.
In the short run, we find that financial inclusion indicators like FAC, FAV, and FUS have significant relationships with income inequality with different directional impacts. For example, immediate increases in accessibility and usage disproportionately favor those who have existing financial literacy and resources, as claimed by Greenwood and Jovanovic (1990); in the short run, FAC and FUS have positive effects. Instead, ADR (adult illiteracy rate) and FAV have short run negative effects, which underscore the need of education and service availability to reduce income inequality quickly. This is in line with the Kuznets Hypothesis, which states that economic development first increases inequality and then decreases it as more inclusive financial mechanisms are made available. The findings of significant bidirectional causality in the relationship between financial inclusion indicators (FAC and FAV) and income inequality confirm the argument that income distribution both affects and is affected by the financial system accessibility as found in the previous studies (Jima & Makoni, 2023).

The results further show that human capital and economic growth reduce inequality. However, the insignificance of HC in both the short and long run means that education investments matter only through other policies, like financially literacy initiatives, to have any meaningful impact on inequality. Empirical evidence from developing regions, e.g. SSA and ASEAN economies, confirms the effectiveness of targeted policies on financial access and human capital development in closing disparities (Azimi, 2022; Beydokhti et al., 2023). The results of this study therefore confirm the importance of policymakers to adopt integrated policies that foster financial development, encourage inclusive growth and invest in human capital in order to sustain significant reductions in income inequalities.

5. Conclusion and Recommendations

This study's findings highlight the complex relationship between financial inclusion, financial development and income inequality, and provide important implications for both theory and practice. Results from the panel ARDL model indicate that financial development and the presence of financial development and financial inclusion have significant long run effects in reducing income inequality. This is in line with theories of Financial Intermediation Theory and the Kuznets Hypothesis that claim that economic inclusivity and reduction in income disparities over time is a result of increased access to financial services. However, the mixed results on financial inclusion accessibility and usage imply that, without targeted interventions, these different aspects of financial inclusion may not only fail to reach those who need it most, but may also end up favouring those who are already financially active, thereby worsening inequality. Furthermore, short run dynamics show that lowering illiteracy and enhancing financial access are an instant solution to income disparities.

The relationships between financial inclusion indicators and income inequality are bidirectionally causal. Not only does income distribution affect the financial accessibility, but also the level of the inclusion and the development in financial systems. These results support the case for broad, inclusive financial policies aimed at these marginalized populations, most so in developing regions where income inequality is most severe.

Recommendations:

1. Expanding financial infrastructure like bank branches, ATMs and digital financial services in underserved rural areas should be a priority for policymakers. To ensure equitable access and meaningful participation it is essential to subsidize financial literacy programs and initiatives that reduce the cost of financial services.

2. The policies of financial inclusion should therefore be directed to resolve structural barriers to the provision of credit and financial services to low income earners and the unbanked population. It includes promoting microfinance projects, and reducing collateral requirements to increase access to credit.
3. Individuals should be empowered to use financial services effectively by incorporating education and financial literacy programs in national development plans. Financial inclusion can be amplified through complementary policies that promote educational outcomes and employment opportunities.
4. Governments should ensure equitable economic growth by creating the enabling environment for small and medium enterprises (SMEs) and promoting innovation as well as balanced regional economic development. Knowing this will help ensure that the benefits of financial inclusion translate into reductions in meaningful inequality.
5. Policymakers should therefore support financial innovations that address the needs of low income groups, so that financial services technological developments are affordable and accessible to all.

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