

FINANCIAL INCLUSION AND POVERTY NEXUS IN DEVELOPING COUNTRIES: AN INSIGHT FROM A PANEL VECTOR AUTOREGRESSIVE MODEL

NKAMA ORJI NKAMA

Department of Accounting, Evangel University Akaeze Ebonyi State, Nigeria.
Email: nkamankama4real@gmail.com

PASCHAL CHIMA ANYANWU

Department of Business Management, Evangel University Akaeze, Ebonyi State, Nigeria.
Corresponding Author Email: paschalchimaanyanwu@gmail.com

DICKSON BEN UCHE

Department of Marketing, Evangel University, Akaeze, Nigeria.
dickson.uche@evangeluniversity.edu.ng

CHUKWUMA NNATE EKE

Department of Accounting, Evangel University Akaeze, Ebonyi State, Nigeria.
Email: chukwumaeke111@gmail.com

UDOKA STEPHEN OTIKA

Department of Marketing, Evangel University, Akaeze, Ebonyi State, Nigeria.
Email: otikaudoka3@gmail.com

Abstract

Most attention has been paid to the impact of financial inclusion on poverty reduction, the causal relationship between financial inclusion and poverty reduction has seen much less attention. The study sheds light on the potential causal links between financial inclusion and poverty reduction in 34 developing countries from 2012 to 2021 using Panel Vector Autoregressive Granger causality (PVAR-GC). The result found that there is bidirectional causality between financial inclusion index and the poverty head count of the selected developing countries. Most interesting is that the causality running from poverty reduction to financial inclusion is much stronger than the causality running from financial inclusion to poverty reduction. Therefore, policymakers should focus on pro-financial inclusion policies, such as promoting greater banking competition or reducing barriers for vulnerable individuals like women, the aged and low-income clients to open bank and mobile money accounts. Also, policies should be directed towards implementation of targeted social protection programs which will alleviate poverty and provide means in including the poor in the formal financial system.

Keywords: Financial inclusion, poverty, Panel Vector Autoregressive Granger causality, developing countries.

1. INTRODUCTION

In the 1950s and 1960s, many developing countries focused on economic growth as a means of achieving their goals. However, this approach did not lead to an improvement in people's living standards, indicating that there was a problem with the narrow definition of development (Sharma & Sharma, 2019). Simply increasing output and income does

not necessarily translate to better quality of life, as important factors such as access to healthcare, education, and social justice are not accounted for in GDP (Goeff, 2003). Poverty reduction requires long-term investments in infrastructure, innovation, and knowledge transfer, and depends on socio-economic institutions and public-private collaborations rather than market forces alone. Despite decades of economic reform, poverty remains a significant issue in developing regions such as Africa, Asia, and Latin America and the Caribbean (Omar & Inaba, 2020; Roser & Ortiz-Ospina, 2018). Although these regions have potential for growth, they are home to the world's poorest and least developed populations and receive significant attention from international aid agencies (Tyler & Gopal, 2010).

Poverty reduction in developing countries has been hindered by low financial inclusion, according to economists (Devarajan & Fengler, 2013). Despite the transformation brought about by globalization, the financial sector in these countries has remained exclusive (Beck, 2016; Derreumaux, 2013). Policymakers at both national and global levels have recognized the importance of financial inclusion in promoting economic development, leading to the establishment of the Maya Declaration in 2011, which set targets for governments of emerging and developing economies to increase financial access (Asuming, et al, 2018; Tita & Aziakpono, 2017; Oji, 2015). Policymakers believe that financial inclusion can help lift people out of poverty by improving their lives and stimulating economic activities. In 2015, the World Bank and other stakeholders launched the Universal Financial Access initiative, with the goal of ensuring that all adults worldwide have access to a transaction account or electronic instrument by 2020 (Kim, Zoo, Lee & Kang, 2018). This would serve as a basic foundation for managing their financial lives and promoting economic growth.

However, underserved individuals face high transaction costs and inconvenience when owning a transaction account in a formal financial institution due to various constraints such as formal identity documentation, high minimum balances, long queues, and service charges (Yah & Chamberlain, 2018; Soumaré, et al., 2016; Karlan, et al., 2016; Oji, 2015; Beck & Demirguc-Kunt, 2008). These lead to a reliance on risky and unregulated informal financial institutions (Oji, 2015). However, the widespread availability of mobile devices such as smartphones and the internet has revolutionized financial services by overcoming geographical and socio-economic barriers through the unique characteristics of mobility, always-on-availability, and personalized small devices (Chinoda & Kwenda, 2019; Kim et al., 2018). Mobile financial services are transforming the traditional banking system in developing countries, aiming to attract the underserved and financially excluded individuals (Andrianaivo & Kpodar, 2011). This innovative technology has significantly enhanced financial inclusion, reducing transaction costs and financial leakages while enabling a switch to a variable cost structure in rural areas (Chatterjee, 2020; Chatterjee & Anand, 2017; Jack and Suri, 2014). Mobile devices allow customers to initiate transactions instantly and check their account balances, eliminating the need to travel to physical bank branches, thereby saving time and expenses (Chinoda & Kwenda, 2019). Mobile financial services provide an opportunity for formal financial institutions to tailor

banking services for the poor and financially excluded individuals who are not reached profitably by the conventional banking system. Finally, access to formal financial services is acknowledged as a means of credit creation and enhances capital accumulation, leading to an increase in the level of wealth creation, especially for the billions of people excluded from formal financial services in developing countries (Okoye, Adetiloye, Erin & Modebe, 2017).

Despite the important role of financial inclusion in economic development, its impact on poverty in developing countries has received little empirical consideration. This study contributes to the literature in two ways. First, we developed a composite index for financial inclusion, which includes mobile money as an indicator. However, there is no consensus on the best measure of financial inclusion (Park and Mercado, 2015). Second, we used the panel vector autoregression Granger Causality (PVAR-GC) (Love & Zicchino, 2006) to investigate the causal relationship between financial inclusion and poverty reduction. The study sheds light on the potential causal links between financial inclusion and poverty reduction in developing countries, and its policy implications can aid in reducing poverty. The rest of the study is structured as follows: Section 2 discussed related literature; Section 3 describes empirical methods and data. Section 4 presents the results and discussion, and Section 5 is the concluding remarks.

2. REVIEW OF LITERATURE

2.1 Concept of Financial Inclusion and Poverty

Financial inclusion involves connecting the unbanked individuals and firms to the formal financial systems so that they can have access to financial services such as payments, insurance institutions, savings and transfers of credits. According to the World Bank Global Financial Report (2014), the lack of use of financial services does not mean a lack of access. Some could accept admission to the financial system but do not make use of certain financial services for the reason of admission barriers, costs and market failures or because of religious beliefs or cultural practices (World Bank, 2014). Sarma (2008) identified financial inclusion as a procedure that promises availability, easy access and use of financial services for all participants in an economy. Sarma's (2008) depiction of financial inclusion forms the idea of availability, accessibility and usage of financial services which can be argued independently. Access to a transaction account is a first step toward broader financial inclusion since it allows people to store money, and send and receive payments. A transaction account can also serve as a gateway to other financial services (Singh, 2017). Providing access to finance is envisaged to reduce poverty level (Galor & Zeira, 1993; Banerjee & Newman, 1993).

Poverty is usually acknowledged as a complex phenomenon liable to varied conceptualizations and definitions. Many of the definitions recognize poverty to be a multidimensional concept. Olowononi (1982) defined poverty as staying in a substandard surroundings considered as slums, dirtiness and totally inadequate without basic social amenities like schools, medical facilities and recreational facilities. In defining poverty,

World Bank (2001) and Ogwumike (1991) depicted it as a condition of low income or insufficient income to meet the basic needs of life. Poverty reflects deprivation in health, education, knowledge and communication, the inability to exercise human rights and the absence of dignity, confidence and self-respect. The basic needs can be categorized as primary and secondary. Primary needs comprise food, water, housing and shelter; while secondary needs consist of economic, social, cultural and political services that include health, education, and security, freedom of expression and religion, access to productive employment, basic infrastructure and credits.

Empirically, there is growing interest on the relationship between financial inclusion and poverty level. Omar and Inaba (2020) examined how financial inclusion affects poverty and income inequality in 116 developing countries from 2004 to 2016. They used the fixed effect estimation method and financial inclusion index to analyze the data. The study found that financial inclusion had a significant positive effect on reducing poverty and income inequality in developing countries. The researchers also discovered that per capita income, age dependency ratio, ratio of internet users, inflation, and income inequality were all factors that significantly influenced financial inclusion levels in developing countries.

Bakari et al (2019) investigated how financial inclusion affects poverty reduction in 49 Sub-Saharan African nations using data from 1980 to 2017. They utilized a static panel data model to analyze the data and discovered that saving, credits to the private sector as a percentage of GDP, access to ATMs and information technology, inflation, and government expenditure significantly contribute to poverty reduction. Conversely, the study found that interest rates and economic growth tend to increase poverty levels. Based on these results, the researchers concluded that financial inclusion can be a valuable approach for reducing poverty in Sub-Saharan Africa.

Yanlin and Chinyu (2019) conducted a study on the effectiveness of inclusive financial development in reducing poverty among the poor with varying labor capacity in Rera, China. The study was based on survey data from China Family Panel Studies and statistics collected from 21 provinces. Their findings suggested that the impact of inclusive finance on poverty reduction varied among the poor with different labor capacities.

In a separate study, Jiang, Tong, Hu, and Wang (2019) investigated the impact of inclusive financial development on farmer entrepreneurship in China from 2004 to 2017. Their results, obtained through static and dynamic panel estimation methods, showed that while there were differences in the level of financial inclusion development among various provinces in China, financial inclusion promoted farmer entrepreneurship.

Neaime and Gaysset (2018) conducted a study using the Generalized Method of Moments (GMM) and Generalized Least Squares (GLS) on eight MENA countries between 2002 to 2015. Their objective was to evaluate how financial inclusion affects poverty, income inequality and financial stability. The results indicated that financial inclusion has a positive impact on reducing income inequality, but there was no significant effect on poverty. They also found that inflation and the country's population contribute to

income inequality, whereas inflation, population and trade openness positively impact poverty. On the other hand, Park and Mercado (2015) examined the relationship between financial inclusions, poverty and income inequality in 37 developing Asian countries using traditional panel OLS from 2004 to 2012. Their findings showed that financial inclusion has a positive impact on reducing poverty and income inequality.

In their research, Agyemang-Badu, Agyei, and Duah (2018) examined the connection between financial inclusion, poverty, and income inequality in Africa. To do this, they created a financial inclusion index for 48 African countries between 2004 and 2015. Using the panel fixed-effect method, they discovered that financial inclusion is indirectly related to poverty and income inequality in Africa.

Uddin, Kyophilavong, and Sydee (2012) conducted research on how the development of the banking sector in Bangladesh relates to poverty reduction over time. To achieve this, they analyzed data from 1976 to 2010 using ARDL and Granger causality econometric models. Their findings suggest that there is a lasting balance between the development of the banking sector and poverty reduction in Bangladesh.

Perez-Moreno (2011) conducted a study that examined the relationship between poverty and financial development in developing countries from 1970 to 1990. The study used a modified version of traditional Granger causality tests to determine possible causal links. The findings of the study suggest that while financial development can moderately decrease poverty, there is no evidence of a causal relationship between poverty and financial development running in the opposite direction.

The study conducted by Ho and Odhiambo (2011) used the ARDL procedure to explore the relationship between financial development and poverty reduction in China. They found evidence of a two-way causal relationship between the two factors in the short term. Therefore, their findings suggest that the poverty-reduction initiatives in China may lead to further growth of the financial sector in the future.

In a separate study, Odhiambo (2010b) used the ARDL testing procedure to investigate the causal relationship between financial sector development and poverty reduction in Zambia. The study discovered that poverty reduction appeared to be the cause of financial sector growth in Zambia over time.

2.2 Theoretical Framework

The impact of financial inclusion on poverty level can be examined through the finance narrowing hypothesis with others such as the supply-leading and the demand following hypothesis. The finance narrowing hypothesis was developed by Galor and Zeira (1993), and Banerjee and Newman (1993). The hypothesis proposed that the poor are deterred from borrowing adequately to meet their investment needs in the human and physical capital because of the presence of financial market imperfections, revealing that financial development helps to improve economic development (Schmeid, 2013). The hypothesis assumes that individuals inherit different quantity of wealth and those with a great amount of wealth invest in education. Those with the smaller initial amount of wealth have to look

for other options to borrowing for investment in human capital. In an underdeveloped financial market, costs of borrowing are much, with those who are incapable of borrowing remaining uneducated or unskilled, which may go on for generations. As the financial markets develop to sustain a growing economy with broader credit services, the poor or less privileged have an opening to borrow for human development and improve their earning potentials. Consequently, the financial market helps to reduce income equality and poverty.

In addition, there are two primary ways in which financial inclusion relates to poverty in theory. Firstly, if financial services are made affordable and accessible to those who are poor and underserved, it will lead to more economic activity, resulting in higher national output and better overall welfare (Adedokun & Ağa, 2021; Nanda & Kaur, 2016; Sahay et al., 2015). Secondly, providing access to deposit and insurance services to those who are unbanked encourages them to save money in banks and non-bank financial institutions. This, in turn, helps to channel funds into the financial markets and allocate them efficiently into long-term investments. This leads to increased employment, income redistribution, poverty reduction, and ultimately more productive output in an economy. This perspective has been suggested by Claessens and Perotti (2007) and Ramkumar (2017).

Empirical evidence is necessary to determine the direction of the relationship between financial inclusion and poverty level. Previous research on the relationship between finance and development has put forward four hypotheses: demand-following hypothesis (DFH) (Odhiambo, 2010; Ho & Odhiambo, 2011), the supply-leading hypothesis (SLH) (Perez-Moreno, 2011), neutrality hypothesis (NH), and feedback hypothesis (FH) (Uddin et al., 2012). The DFH argues that development drives the demand for financial services, which improves institutional efficiency and diversifies investment risks. The SLH suggests that the financial sector precedes economic development by increasing efficiency and capital accumulation. However, the NH envisaged no relationship between the financial sector and development. The FH suggests that there is a bidirectional causal relationship between development and the financial sector, where they influence each other simultaneously. Since, there is no agreement among researchers, it is crucial to examine the casual relationship between financial inclusion and poverty among developing countries.

3. METHODOLOGY AND DATA

3.1 Methodology

To examine the causal relationship between general financial inclusion index and poverty in selected developing countries, we specify the following dynamic panel models using a six variable PVAR following the study by Omar and Inaba (2020);

$$Z_{it} = \tau_1 Z_{it-1} + f_i + d_t + \varepsilon_{it} \quad (1)$$

Where Z_{it} represents a six-variable vector, f_i is the specific time invariant effect; d_t represents country specific time dummies and ε_{it} is the error term with independently and identically distributed (i.i.d). The modified model is specified as follows,

$$\begin{aligned} \ln povhead_{it} &= \sum_{j=1}^p \gamma_1 \ln povhead_{it-j} + \sum_{j=1}^p \gamma_2 \ln gfii_{it-j} + \sum_{j=1}^p \gamma_3 \ln gdppc_{it-j} + \\ &\quad \sum_{j=1}^p \gamma_4 \ln ssenroll_{it-j} + \sum_{j=1}^p \gamma_5 \ln govtexp_{it-j} + \sum_{j=1}^p \gamma_6 \ln tradeopen_{it-j} + \\ &\quad f_i + d_t + \varepsilon_{it} \\ \ln gfii_{it} &= \sum_{j=1}^p \phi_1 \ln gfii_{it-j} + \sum_{j=1}^p \phi_2 \ln povhead_{it-j} + \sum_{j=1}^p \phi_3 \ln gdppc_{it-j} + \\ &\quad \sum_{j=1}^p \phi_4 \ln ssenroll_{it-j} + \sum_{j=1}^p \phi_5 \ln govtexp_{it-j} + \\ &\quad \sum_{j=1}^p \phi_6 \ln tradeopen_{it-j} + f_i + d_t + \varepsilon_{it} \end{aligned} \tag{2}$$

Where $\ln povhead$ = log of poverty headcount ratio, $\ln gfii$ = log of financial inclusion index, $\ln gdppc$ = log of per capita real GDP, $\ln ssenroll$ = log of secondary school enrolment ratio, $\ln govtexp$ = log of government expenditure, $\ln tradeopen$ = log of trade openness.

The Panel-Vector Autoregressive (PVAR) Granger Causality Test was developed by Holtz- Eakin, Newey and Rosen (1988) although the traditional approach was developed by Sims (1980). The model is an alternative to the simultaneous equation model and in particular. VAR model is seen as an *a-theoretic* model since they overlook economic restrictions. The PVAR model is appropriate for the study as it overcomes the difficulty associated with differentiating exogenous and endogenous variables in a system of simultaneous relationship. The Panel-Vector Autoregressive Model (PVAR) is the combination of the traditional VAR method (looking at all variables as endogenous), and the panel-data method (allowing for unobserved individual heterogeneity) with fixed effects which gives a consistency of the estimation (Love and Zicchino, 2006).

Thus, the study specifies the following PVAR model where the financial inclusion index is identified as the disturbance term in an equation of the form

$$Z_{it} = \phi_i + A(L)Z_{it} + f_i + \varepsilon_{it} \tag{3}$$

Given that the innovations possess the following: $E[\varepsilon_{i,t}] = 0$, $E[\varepsilon'_{i,t}\varepsilon_{i,t}] = \Sigma$ and $E[\varepsilon'_{i,t}\varepsilon_{i,s}] = 0$ for all $t > s$.

Where ϕ_i , is the vector of constant terms for each variable, $A(L)$ is the lag operator, and Z_{it} represents a vector of all endogenous variables? Subscripts i and t are country and time observations respectively while f_i denotes the fixed effect, while $\varepsilon_{i,t}$ represents the vector of idiosyncratic errors. The above parameters in equation 3 may be estimated with the fixed effects jointly or, without the fixed effects after transformation, and applying equation-by-equation ordinary least squares (OLS). Given that lagged dependent variables will appear in the right-hand side of the system of equations even with large N,

estimates would still be biased (Nickell, 1981), though the bias will be approaching zero with larger N (Judson and Owen, 1999).

However, the GMM based approach has been proposed for consistent estimates, especially in large N and fixed T method when the i.i.d assumption is not satisfied (Love and Zicchino, 2006). The first-difference transformation approach may yield a consistent estimate in the equation-by-equation by using the lagged differences as instruments with differences and levels from earlier periods (Anderson and Hsiao, 1982). But the first-difference transformation creates a problem in unbalanced panels by increasing the gap. A forward orthogonal deviation proposed by Arellano and Bover (1995) could act as an alternative transformation method which does not possess the weaknesses of the first-difference transformation. It subtracts the average of all available future observations instead of using the deviation from past realisation thereby minimising data losses. Efficiency could improve by including a longer set of lags as instruments, but it has the property of reducing observations with missing observations. According to Holtz-Eakin, Newey and Rosen (1988), allowing instruments with observed realisations, and observations that are missing substituted with zero on the assumption that the instrument list is truly exogenous. They pointed out that although equation-by-equation GMM estimation provides consistent estimates, a system of equations model may lead to efficiency gains.

VAR coefficients are not easy to interpret because the models are multivariate in nature. Given that, impulse response functions and variance decompositions were developed to overcome this difficulty. The impulse response function shows in equilibrium, how a stable model reacts to shocks to any of the regressors. This impulse, either permanent or temporary distributes through the model and the way the response variable after the disturbance returns to equilibrium. Variance decompositions reveal the percentage of forecast variance in a single variable of the VAR that is explained by innovations of all variables within the PVAR.

3.2 Data

This study sourced all data from the World Bank *World Development Indicators* and International Monetary Fund *Financial Access Survey* for 34 developing countries from 2012–2021. The countries are Afghanistan, Albania, Armenia, Bangladesh, Benin, Botswana, Burkina Faso, Cambodia, Cameroon, Cote d'Ivoire, Fiji, Ghana, Guinea, Guyana, Kenya, Lesotho, Madagascar, Mali, Mauritius, Mozambique, Myanmar, Namibia, Niger, Nigeria, Pakistan, Philippines, Rwanda, Samoa, Senegal, South Africa, Tanzania, Thailand, Togo, Uganda and Zambia. The choice of the countries is due to consistent and comparable macro-level data on financial inclusion especially on mobile money. It is probable that indicators of financial inclusion are interrelated. Thus, an index is created using Principal Component Analysis (PCA), which transforms multiple indicators into a new index that is not correlated and provides information on a different dimension (Akanbi, 2015). The PCA process identifies how a particular principal component, calculated through the sample's covariance matrix eigenvalues, explains the

variance of a variable. These eigenvalues indicate the variances of the financial inclusion indicators, and the number of variables matches the number of principal components. Typically, the first principal component explains the majority of the variable's variance, so the index calculation uses its value. The data itself assigns weights, which is a significant benefit of PCA. Table 1 shows the summary of variable description.

Table 1: Summary of Model Variables Description

Variable	Description	Measure	Designation	Source
<i>POVHEAD</i>	Poverty headcount ratio - Percentage of total population living on less than USD 2.50 per day	Annual	Endogenous variable	Global Consumption and Income Project (GCIP Database, 2021)
<i>GFII</i>	General financial inclusion index - Composite financial inclusion index consists of penetration, availability, and usage dimensions of financial inclusion. Penetration dimension includes number of deposit accounts with commercial banks, credit unions and credit cooperatives per 1,000 adults, and number of registered mobile money accounts per 1,000 adults. Availability dimension of financial inclusion are Number of commercial bank, credit union, credit cooperative and all microfinance institution branches per 100,000 adults, number of Automated Teller Machines (ATMs) per 100,000 Adults, and number of registered mobile money agent outlets per 100,000 adults. Usage dimension of financial inclusion are outstanding deposits with commercial banks, credit unions and credit cooperatives (% of GDP), outstanding loans from commercial banks, credit unions, credit cooperatives and all microfinance institutions (% of GDP), and mobile money transactions - Value of mobile money transactions (% of GDP).	Computed by using PCA	Endogenous variable	Financial Access Survey database of the IMF, 2021
<i>GDPPC</i>	Per capita real GDP - Per capita real GDP at constant 2010 USD	Annual	Control Variable	World Bank, World Development Indicators, 2021

<i>SSENROLL</i>	Secondary school enrollment ratio - Gross secondary school enrolment as a percentage of total population, regardless of age	Annual	Control Variable	World Bank, World Development Indicators, 2021
<i>GOVTEXP</i>	Government Expenditure - General government final consumption expenditure as a percentage of GDP	Annual	Control Variable	World Bank, World Development Indicators, 2021
<i>TRADEOPEN</i>	Trade openness measured by Export + Import as a percentage of GDP	Annual	Control Variable	World Bank, World Development Indicators, 2021

4. FINDINGS AND DISCUSSION

4.1 Preliminary Tests

Table 2 presents the descriptive statistics of the variables used for the study. A maximum of total of 272 observations, from 2012 to 2021 for 34 selected developing countries. The summary statistics in Table 2 shows that *lnPOVHEAD* averaged 0.895 and ranged from -2.119 to 2.208, *lnPDI* averaged 8.99×10^{-10} ranging from -3.75 to 1.593, and *lnGFII* averaged 6.92×10^{-10} respectively. Further, *lnGDPPC* averaged 3.214 and ranged from 0.2.668 to 4.037, *lnSSEN* averaged 0.996 ranging from 0 to 2.082, and *lnGEX* averaged 1.06 ranging from 0 to 1.608, while *lnTOP* average 1.704 ranging from 0 to 2.177.

Table 2: Summary Statistics of Variables used for 34 Developing Countries

VARIABLE	OBS.	MEAN	STD. DIV.	MIN.	MAX.
<i>lnPOV</i>	272	0.89510	0.835844	-2.1189	2.2075
<i>lnGFII</i>	272	$6.92e - 10$	1.89025	-6.67746	3.25623
<i>lnGDPPC</i>	272	3.2143	0.38138	2.66782	4.03712
<i>lnSSEN</i>	272	0.99552	0.87280	0	2.08153
<i>lnGEX</i>	272	1.06039	0.32879	0	1.60802
<i>lnTOP</i>	272	1.70465	0.46412	0	2.17669

Source: Author's Computation

Principal Component Analysis (PCA)

Table 3 presents the principal component analysis (PCA) for the dimensions of financial inclusion as well as the general financial inclusion index. The Kaiser (1974) and Jolliffe (2002) criterion is used to maintain the common factors. The criterion is that an eigenvalue greater than one should be retained. Consequently, the general financial inclusion (GFII), which explains more than 81.1% of the information in the eight financial inclusion

indicators, is with an eigenvalue of 3.57 and 2.33 for first and second principal component respectively.

Table 3: Principal Component Analysis (PCA) for Composite Financial Inclusion

Principal Component	Component Matrix (Loadings)								Proportion	Cumulative Proportion	Eigen Value
	lnFI1	lnFI2	lnFI3	lnFI4	lnFI5	lnFI6	lnFI7	lnFI8			
First PC(GFII)	0.364	0.079	0.430	0.455	0.019	0.474	0.489	-0.068	0.446	0.446	3.573
Second PC	-0.04	0.575	-0.051	-0.094	0.615	0.049	0.075	0.519	0.291	0.738	2.331
Third PC	0.715	0.333	-0.289	0.084	0.119	-0.221	-0.257	-0.399	0.087	0.825	0.695

Source: Author's Computation

PC = Principal Component, lnFI1 = log of deposit accounts, lnFI2 = log of mobile money accounts, lnFI3 = log of bank branches, lnFI4= log of ATMs, lnFI5 =log of mobile money agents, lnFI6 = log of outstanding deposits, lnFI7 = log of outstanding loans, lnFI8 = log of mobile money transactions, PDI = penetration dimension index, ADI = availability dimension index, UDI = usage dimension index, lnGFII = log of general financial inclusion index.

Correlation Matrix

The study presents the correlation matrix in Table 4 for the selected variables. The correlation matrix shows a mixed relationship between the regressors and the regressand. There is a negative relationship between the log of poverty headcount ratio (*lnPOV*) and every independent variable except the log of secondary school enrolment (*lnSSEN*) where there is positive relationship. Also, to ascertain multicollinearity in the models, the regressors are checked for high level correlation. Asumadu-Sarkodie and Owusu (2017) and Prodan (2013) proposed that regressors with correlation higher than 80 percent should not be included together in the same model. Therefore, the correlation matrix in Table 4 established that there is no multicollinearity problem in the model.

Table 4: Correlation Matrix of the selected variables

	<i>lnPOV</i>	<i>lnGFII</i>	<i>lnGDPPC</i>	<i>lnSSEN</i>	<i>lnGEX</i>	<i>lnTOP</i>
<i>lnPOV</i>	1					
<i>lnGFII</i>	-0.483	1				
<i>lnGDPPC</i>	-0.616	0.620	1			
<i>lnSSEN</i>	0.035	0.039	0.031	1		
<i>lnGEX</i>	-0.100	0.219	0.062	0.033	1	
<i>lnTOP</i>	-0.114	0.341	0.108	0.003	0.747	1

Source: Author's Computation

Test for Lag Length Selection

In this section, the study applied a consistent moment and model selection criteria (MMSC). It incorporated the generalised method of moments (GMM) based on J statistic of over-identifying restrictions as recommended by Andrews and Lu (2001). Table 5

reveals a summary of the result. Based on the three model selection criteria recommended by Andrews and Lu (2001) in which the smallest MMSC is required. The first – order Panel VAR is preferred because it has the smallest MBIC, MAIC and MQIC as seen in Table 5.

Table 5: Results for Lag Selection Criteria

Lag	CD	J	J p-value	MBIC	MAIC	MQIC
1	1	110.288	0.226417	-380.9775	-89.71197	-208.0749
2	1	73.99402	0.184221	-240.4159	-54.00598	-129.7582
3	1	42.58312	0.038170	-94.97122	-13.41688	-46.5585

Source: Author's Computation

4.2 Discussion of Findings

In this study, we used the Panel VAR Granger causality testing to examine the casual relationship between financial inclusion and poverty level in developing countries. Table 6 presents the causality of the six variables in our model. The presence of causality between the variables in each model is verified only if the p-value is at a significant at 5% level. In the first causal relationship, the p-value of the log of government expenditure (*InGOVEXTP*), log of trade openness (*InTRAOPEN*), log of secondary school enrolment (*InSSENROLL*) and log of general financial inclusion index (*InGFII*) are less than 0.05 significant level. However, the log of GDP per capita is greater than significant level. Therefore, government expenditure, trade openness, secondary school enrolment and general financial inclusion index Granger causes poverty per head count but no causality running from GDP per capita to poverty per head count. In the second causal relationship, the p-value of the log of poverty per head count (*InPOVHEAD*), log of government expenditure (*InGOVEXTP*), log of trade openness (*InTRAOPEN*) and the log of GDP per capita are less than 0.05 significant level. However, log of secondary school enrolment (*InSSENROLL*) is greater than 5% significant level. Therefore, poverty per head count, government expenditure, trade openness, and general financial inclusion index granger causes log of general financial inclusion index (*InGFII*) but no causality running from secondary school enrolment to log of general financial inclusion index (*InGFII*).

Table 6: Panel Granger Causality Test

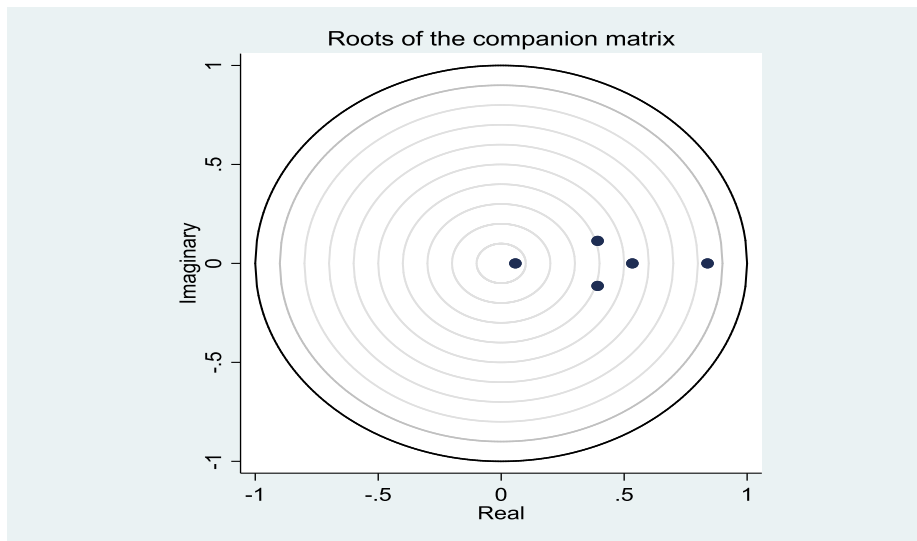
Dependent Variable	Excluded	Chi-sq	df	Prob.
InPOVHEAD	InGOVEXTP	70.699	1	0.000
InPOVHEAD	InTRAOPEN	60.957	1	0.000
InPOVHEAD	InSSENROLL	16.163	1	0.000
InPOVHEAD	InGFII	6.393	1	0.011
InPOVHEAD	InGDPPC	0.900	1	0.343
InGFII	InPOVHEAD	24.750	1	0.000
InGFII	InGOVEXTP	18.712	1	0.000
InGFII	InTRAOPEN	169.560	1	0.000
InGFII	InSSENROLL	0.129	1	0.719
InGFII	InGDPPC	64.385	1	0.000
J-Stat = 110.228				

P-value = 0.226			
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Source: Author's Computation

The calculated J-statistic of 110.288 with a p-value of 0.226 is greater than 0.05 significant levels. The null hypothesis for the Hansen J – statistics is that the instruments are valid. Therefore, the study does not reject the null hypothesis, which means that our instrument set is appropriate. Having conducted the estimation, the model is also checked for the performance of the necessary assumptions core to the working of the model and its predictive power. Firstly, the study introduced the Huber/White/Sandwich estimator to correct for the possible heteroscedasticity and autocorrelation. Secondly, the study also check the stability condition for the panel VAR system. The stability condition states that the inverse characteristic root of the polynomial must be less than one. The eigenvalues from our panel VAR regression are all less than 1 and within the unit circle (see *Figure 1*). The probable interpretation of the result is that the dynamics of the model converges at a point. There will be long-run equilibrium as each of the eigenvalues is less than 1.

Figure 1: Model Stability Test



Source: Authors' Computation

Most attention has been paid to the impact of financial inclusion on poverty reduction, the causal relationship between financial inclusion and poverty reduction has seen much less attention. In this context, we attempts to look at the causal links between financial inclusion and poverty reduction in developing countries to shed more light on the probable causal linkages. Our study then found that there is bidirectional causality between financial inclusion index and the poverty head count of the selected developing countries. Most interesting is that the causality running from poverty reduction to financial inclusion is much stronger with a probability value of 0.000 than the causality running from financial inclusion to poverty reduction. The bidirectional causality is in consonance with Uddin et al. (2012) in Bangladesh where they discovered bidirectional relationship between

financial development and poverty rate. It is also in part supports the findings of Perez-Moreno (2011) in developing economies where they found that financial development granger caused poverty reduction. On the other, it supports Odhiambo, (2010b) in Zambia and Ho and Odhiambo (2011) in China stating that poverty reduction granger causes financial development. The direction of the causality suggests that poverty reduction may encourage demand for financial services, and may induce political pressures to build more efficient financial systems. Also, our findings are suggestive that policymakers can influence the reduction of poverty by encouraging financial sector development. Sound financial sectors will promote better and more access to institutional credits availability to the people, who are living in poverty. Financial inclusion has been identified as a crucial aspect of sustainable development, particularly in developing countries, where access to financial services is closely linked to economic opportunities. This is especially beneficial for the poor, as it allows them to save, access credit, and invest in their future. Organizations such as the World Bank and local financial institutions have made efforts to provide access to formal financial services for the majority of people, which has contributed to the overall efficiency of the financial system. Although the financial sector in developing countries has historically been exclusive, recent globalization and transformation have led to growth and a shift towards more inclusive financial systems. Our research shows that financial inclusion has a positive impact on the poor by increasing their savings prospects, which can help alleviate their liquidity constraints and facilitate investments in human and physical capital. As they continue to save, they can improve their credit access and overall financial well-being, ultimately leading to poverty reduction on a global scale.

5. CONCLUSIONS AND POLICY IMPLICATION

This study examined the casual relationship between financial inclusion and poverty reduction in selected developing countries from 2012 to 2021. The study employed panel Granger causality test. The issue of the relationship between financial inclusion and poverty rate has generated considerable debate among economists and financial experts over the years. The debate primarily revolves around two major questions: Firstly, is there any relationship whatsoever between financial inclusion and poverty? Secondly, if any, what could be the nature of the relationship and direction of causality, that is, does financial inclusion promote poverty reduction or is it poverty reduction that fosters financial sector development in extension, financial inclusion? The results originating from this study are quite revealing for developing countries. The study found that there is bidirectional causality between general financial inclusion index and the poverty head count of the selected developing countries.

Therefore, with the findings in our study, we advocate that: first, pro-financial inclusion policies, such as promoting greater banking competition or reducing barriers for vulnerable individuals like women, the aged and low-income clients to open bank and mobile money accounts should alleviate frictions that prevent access to, and usage of financial services. This policy should include proper financial system reforms should be

introduced targeted at improving the financial market imperfections allowing the low income group access loans needed for education and health in order to improve their chances of earning more. Also, Monetary authorities should play effective role in ensuring that cost of funds to the rural populace is reasonably priced, and that rural banks do not just accumulate deposits but give out sufficient loans to the poor in the rural sector.

Secondly, policies should be directed towards implementation of targeted social protection programs. These programs could include measures such as cash transfers, conditional cash transfers, or vouchers, aimed at providing direct financial support to vulnerable populations, such as those living in extreme poverty, the elderly, or single-parent households. This will also help the poor open bank accounts as a channel for those cash transfers. By providing financial assistance to those in need, social protection programs can help address immediate poverty alleviation needs, improve access to basic necessities such as food, healthcare, and education, and provide a safety net during times of economic shocks or crises. Additionally, conditional cash transfer programs, which provide financial assistance in exchange for certain behaviors, such as sending children to school or accessing healthcare can also promote human capital development and break the cycle of poverty by investing in the education and health of future generations. It's important to note that the design and implementation of social protection programs should be context-specific and take into consideration the unique socio-economic, cultural, and political context of each developing country. They should also be accompanied by measures that promote long-term economic growth, such as investments in infrastructure, education, and job creation, to create sustainable pathways out of poverty. Monitoring, evaluation, and proper targeting mechanisms should also be in place to ensure that the intended beneficiaries are reached effectively and efficiently, and that the programs are achieving their poverty reduction goals.

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