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Research

IMPACT OF HEALTH INEQUALITY ON LABOUR PRODUCTIVITY IN SUB-SAHARAN AFRICA

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Abstract: This study examines the impact of health inequality on labour productivity in Sub-Saharan Africa using Panel Autoregressive Distributed Lag (Panel ARDL) techniques across 46 Sub-Saharan African countries. The study was motivated by the growing concern over persistent health disparities and their implications for labour market performance and economic development in the region. Data were analyzed to evaluate the relationship between health inequality, health expenditure, population growth, and labour productivity. The findings revealed that health inequality has a significant negative relationship with labour productivity, indicating that disparities in health outcomes reduce workers' efficiency and productive capacity. Similarly, health expenditure was found to negatively influence labour productivity, suggesting possible inefficiencies in healthcare spending and weak healthcare delivery systems within the region. In contrast, population growth exhibited a positive relationship with labour productivity, implying that an increasing population may enhance labour supply and economic activities when properly harnessed. The study concludes that health inequality and ineffective healthcare expenditure constitute major impediments to labour productivity in Sub-Saharan Africa, while population growth can serve as a productive asset if adequately managed. Based on these findings, the study recommends the design and implementation of multi-level health equity policies aimed at reducing disparities in healthcare access, quality, and outcomes across income groups, geographic regions, and gender. The study further recommends expanding primary healthcare facilities, mobile clinics, and outreach services in rural and underserved communities, alongside strengthening social health insurance schemes, subsidized healthcare programs, and conditional cash transfer initiatives to reduce financial barriers to healthcare access and improve labour productivity in the region.
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1.0 INTRODUCTION

Globally, the relationship and interrelationship between health and economic growth have been well-documented. The World Health Organization (2021) has it that a good health outcome tends to improve labour force and higher rates of economic development. A healthier population is more likely to engage in meaningful employment, contribute to economic activities, and strived toward higher education. However, countries with serious health disparities face economic challenges such as low labour productivity, higher healthcare costs, and reduced level of human capital development (Bloom & Canning, 2008). Nevertheless, while these relationships are plain in developed economies, the nature of the relationship between economic growth and health inequality in Sub-Saharan Africa (SSA) remains a mirage.

The issue of health inequality has recently been given wide attention in developed and developing economies. Health is an important component that plays the role of transmitting economic growth and development (Case, et al, 2002; Case & Paxson, 2010). According to the World Health Organization (WHO) "health inequalities are systematic differences in the health status of different population group" this includes life expectancy, avoidable mortality, health condition and mental ill health. These disparities often arise due to differences in socioeconomic status, geographical location, race and other demographic factors (Marmot, 2005). The National Health Services England (2024) also defines health inequality as an unfair and avoidable differences in health across the population, and between differences groups within society. This include longevity of people, the health situations they may experience and the healthcare that is available to them. Over the years, substantial evidence has demonstrated that inequality has harmful effects across multiple dimensions of development. Studies show that rising inequality slows long-term economic growth by limiting human capital development and reducing broad participation in productive activities (OECD, 2015; Ostry et.al, 2014). Research also confirms that inequality weakens the impact of growth on poverty reduction, as the benefits of growth accrue disproportionately to higher-income groups (Ravallion, 2014; World Bank, 2016). Furthermore, scholars have linked inequality to declining social cohesion, lower interpersonal trust, and greater risks of social and political instability (UNDP, 2019; Wilkinson & Pickett, 2010). There is also strong evidence that inequality is associated with poorer public health outcomes, including lower life expectancy and higher disease burdens (WHO, 2015; Pickett & Wilkinson, 2015). This global pattern is mirrored in Sub-Saharan

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Africa, where inequality continues to undermine economic and health outcomes and constrains social and human development (Taffa et al., 2020).

Health inequality in SSA manifests in various forms, ranging from unequal access to healthcare services to sharp differences in health outcomes which include infant mortality, life expectancy, and disease prevalence. In 2021, the World Health Organization reported that SSA continues to bear a disproportionate share of the global disease burden, with high incidences of communicable diseases such as malaria, tuberculosis and HIV/AIDS. In recent years, Sub-Saharan Africa has experienced a substantial and growing burden of non-communicable diseases (NCDs), with the region's foremost NCDs cardiovascular diseases, cancers, diabetes, and chronic respiratory diseases which account for a large share of premature deaths estimated at 1.6 million adults aged 30-70 die annually from major NCDs in the region. (WHO African Region, 2024). This burden disproportionately impacts low-income and rural populations, where limited healthcare infrastructure, insufficient resources, and socioeconomic disadvantage result in poorer risk-factor profiles and lower overall health-related quality of life (Ramalivhana et al., 2024). In countries like Nigeria, the economic consequences of NCDs further deepen inequality, as households increasingly face out-of-pocket payments for chronic disease care (Odunyemi et al., 2023). The situation has been aggravated by disruptions in health service delivery due to the COVID-19 pandemic, which interrupted routine NCD care and compounded access challenges across the region. Together, these trends highlight how rising NCD prevalence, weak health systems, and structural inequalities converge to exacerbate health disparities across Sub-Saharan Africa.

From a macroeconomic perspective, the cumulative effect of health inequality is reduced total factor productivity and slower economic growth. In Sub-Saharan Africa (SSA), where a large share of the workforce is informal and dependent on physical labor, the productivity implications of unequal health access are particularly severe. For example, malaria and HIV/AIDS diseases with high prevalence among the poor significantly reduce working hours and life expectancy, diminishing the region's human capital (Sachs & Malaney, 2002). It is against this backdrop that this paper sought to examine the impact of health inequality on labour productivity in Sub-Saharan Africa.

2.0 LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Conceptual review

Concept of Health

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Understanding what "health" means is an essential starting point for exploring how health inequality affects economic growth. Across disciplines, health is recognized as a multidimensional concept that goes beyond simply avoiding illness. The classic WHO definition describes health as complete physical, mental, and social well-being (WHO, 1948), but this idealized view has been widely debated for being too absolute. As a result, scholars and global health institutions have developed broader and more practical interpretations.

The WHO's Ottawa Charter (1986) reframes health as a *resource for everyday life*, highlighting that good health enables people to function, participate in society, and pursue meaningful goals. This perspective aligns with the idea that health supports productivity and economic contribution.

More traditional biomedical views define health as the absence of disease or biological problems (Boorse, 1977), but this approach is limited because it overlooks social, psychological, and environmental influences. The biopsychosocial model introduced by Engel (1977) addresses this gap by showing that health is shaped by the interaction of biological conditions, mental states, and social environments. Together, these perspectives show that health is a complex and dynamic concept influenced by biological, economic, social, and environmental forces. This comprehensive understanding provides a strong foundation for examining how health inequalities arise and how they ultimately affect economic growth in Sub-Saharan Africa.

Concept of Health Inequality

Health inequality remains a pressing concern in Sub-Saharan Africa (SSA), where disparities in health status and access to healthcare services persist across income groups, regions, and socio-demographic lines. Defined as the systematic differences in the health status of different population groups, health inequality often reflects broader socio-economic inequalities and contributes to a cycle of poverty and underdevelopment (Marmot, 2005). This review explores the intricate relationships between health inequality and various economic development indicators in SSA, including GDP per capita growth, poverty, human capital development, health expenditure, and labor force participation.

Health inequality is a multifaceted phenomenon that reflects the unjust and avoidable disparities in health outcomes between different population groups. It can be conceptualized through various lenses, including socioeconomic status, geographic location, gender, ethnicity, and age. The World Health Organization defines health

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inequalities as differences in health status or in the distribution of health determinants between different population groups (WHO, 2010).

There are two main types of health inequalities: vertical and horizontal. Vertical inequalities are based on a continuous scale, often relating to income or education. These inequalities manifest when individuals with higher socioeconomic status experience better health outcomes than those lower on the scale (Wagstaff et al., 2001). Horizontal inequalities, on the other hand, occur between groups with different identities or backgrounds such as ethnicity, gender, or geographic location regardless of socioeconomic status. For instance, rural populations in SSA often face limited access to healthcare facilities compared to urban dwellers, contributing to worse health outcomes.

Health Inequality and Labor Productivity

Health inequality refers to the systematic disparities in health outcomes and access to healthcare services across different population groups, often determined by socioeconomic status, geography, gender, ethnicity, or education (Marmot, 2005; WHO, 2010). These inequalities are not random but are rooted in social, economic, and political structures that create uneven exposures to health risks and unequal access to care. Health inequality manifests in various forms, including differences in life expectancy, infant and maternal mortality, disease burden, and access to preventive and curative services. In the context of labor productivity, health inequality is particularly important because it shapes individuals' physical and mental capacity to participate effectively in the labor market.

Labor productivity, on the other hand, is defined as the output produced per unit of labor input (usually per worker or per hour worked) and is a key indicator of economic efficiency and growth potential (OECD, 2017)

. In economies that depend heavily on human capital, labor productivity is strongly influenced by the health status of the workforce. A healthy worker is more likely to be present, focused, and efficient, while poor health reduces work capacity, increases absenteeism, and contributes to early withdrawal from the labor force (Bloom & Canning, 2000).

Health inequality can negatively affect labor productivity in three principal ways:

- **Direct Impact on Individual Capacity:** Workers in poor health are less able to engage in physically demanding or cognitively intense tasks. Chronic illnesses, malnutrition, or mental health disorders reduce stamina, concentration, and motivation, lowering output (Strauss & Thomas, 1998). When these health challenges

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disproportionately affect marginalized groups, the aggregate productivity of the labor force suffers.

- **Increased Absenteeism and Presenteeism**: Workers facing health issues tend to miss work more often (absenteeism) or remain at work while unwell (presenteeism), both of which reduce productivity (Goetzel et al., 2004). In unequal health systems, lower-income or rural workers may delay seeking care due to costs or access barriers, exacerbating the severity of illnesses and their productivity losses.
- **Intergenerational Effects:** Health disparities that begin in childhood such as malnutrition, stunting, or exposure to infectious disease can affect cognitive development and educational attainment, ultimately influencing adult productivity (Glewwe & Miguel, 2008). Regions or population groups with persistent health inequality are likely to experience long-term labor productivity deficits.

Theoretical Review

Human Capital Theory

Michael Grossman's propounded the model of investment in health capital in 1972. This has provided a breakthrough of the manner economic researchers model healthcare related behavior (Grossman, 1972). The model by Grossman is strongly in the tradition of Becker "Human Capital theory" the Grossman model presumes that "the individual is a forward looking, optimizing individual who, in making decisions today, takes account of their possible future consequences" In the Grossman's model, the components provided that "an individual's fundamental state of health is treated as a capital good, to be built up by investment and run down by lack of investment" Thus it is not a goods that can be obtain immediately. A person who desires to raise his wealth of health capital to a particular target can only do so over period time. Health Capital in this case is conceived to be different from how healthy a person happens to be. The state of sickness or even severe sickness, may not essentially lessen one's wealth of health capital, regardless of how much it might lessen one's immediate state of satisfaction. Health capital is the best idea of relating to a person's capability to withstand disease, and to execute what the health care researchers termed as activities of daily life. For instance, a severe arthritis, which can make a person to have difficult going upstairs or downstairs, does reflect a reduction in the person's stock of health capital (Grossman, 1972).

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Demographic Transition Theory

Demographic transition is the factual movement in demographics from soaring infant mortality and birth rates in a given community that has little economic growth and education, to demographics of decreased death and birth rates in a community with high level of technology, education and economic growth, to the phase between these two scenarios. Although the shift has taken place in many industrialized countries. This theory and methodology are often inaccurate when applied to different nations because of specific socio-economic and political factors influencing specifically populations (Notestein, 1953).

The theory of demographic transition is drawn from an exposition to demographic account which began in 1929 by a demographer in America named Warren Thompson from 1887 to1973. Similar observation was also made by Adolphe Landry from France on the issue of demographic marking and development of population potentials within 1934s. Frank W. Notestein in the 1940s-1960s also review a more comprehensive demographic transition theory. By 2009, the extant of a pessimistic coexistence between productiveness and industrial growth had become one of the keys generally acceptable findings the field of social science (Dyson, 2009).

Empirical review

The empirical literature on health inequality and labor market outcomes in Sub-Saharan Africa overwhelmingly shows that disparities in health status and healthcare access negatively affect labor force participation, employment, productivity, and overall labor market efficiency. Most of the reviewed studies employed panel econometric techniques such as Fixed Effects (FE), Random Effects (RE), Generalized Method of Moments (GMM), Ordinary Least Squares (OLS), Structural Equation Modeling (SEM), quantile regression, cointegration, and Error Correction Models (ECM) using panel data covering several Sub-Saharan African countries between 2000 and 2020. Despite methodological differences, there is a broad consensus that health inequality reduces individuals' productive capacity and weakens labor market performance across the region.

A major strand of the literature focused on labor force participation. Studies by Olowu and Ojo (2021), Durojaiye and Ogundipe (2021), Adewole and Adetunji (2020), Adeola and Bankole (2021), Eze and Ayeni (2020), Olufemi and Niyi (2021), and Oluwatimilehin and Oyebanji (2021) consistently found that health inequality significantly reduces labor market participation. These studies revealed that poor health outcomes and unequal access to healthcare services limit individuals' ability to actively engage in

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economic activities. The negative effects were found to be more pronounced among vulnerable populations such as women, youths, rural dwellers, low-income households, and the elderly. Similarly, Idris and Adebiyi (2020) observed that weak healthcare infrastructure exacerbates unemployment and lowers labor force participation across many Sub-Saharan African countries.

Another major theme in the literature is the effect of health inequality on labor productivity and economic efficiency. Adebayo and Ajayi (2020), Babatunde and Olanrewaju (2021), Ogunleye and Durojaiye (2020), Ayodele and Olorunfemi (2020), Ojo and Agboola (2021), and Kanu and Bamidele (2021) all concluded that health inequality significantly lowers labor productivity. These studies attributed the decline in productivity to poor health conditions, reduced working hours, absenteeism, lower physical and mental work capacity, and limited skill acquisition. Adebayo and Ajayi (2020) further emphasized that health inequality indirectly affects productivity through poor educational attainment and weak human capital development. Likewise, Ogunbiyi and Okunade (2020) and Akinyemi and Babajide (2021) found that health inequality contributes to inefficiencies in labor markets by reducing both productivity and employment rates, especially in labor-intensive sectors.

Several studies also linked health inequality with broader economic outcomes. Agboola and Akinmoladun (2020), Ajao and Adeola (2021), Omotayo and Olugbenga (2020), and Ogunmodede and Alabi (2021) established that health inequality negatively affects economic output and employment opportunities in both the short and long run. These studies demonstrated that unequal healthcare access and poor health conditions reduce workers' efficiency and productive contribution to the economy, thereby constraining sustainable economic growth. Abubakar and Ajayi (2021) specifically highlighted that disparities in maternal and child health outcomes create significant inefficiencies within labor markets.

Furthermore, some studies emphasized the unequal distributional effects of health inequality. Oloruntoba and Akinleye (2020), using quantile regression analysis, found that the adverse effects of health inequality are disproportionately concentrated among lower-income populations. Their findings suggest that improving health equity could substantially increase employment opportunities and labor participation among disadvantaged groups. Similarly, several studies stressed that regions with poor healthcare systems and limited healthcare access experience the strongest negative labor market

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outcomes. This empirical literature demonstrates a strong consensus that health inequality constitutes a major barrier to labor market participation, productivity, employment generation, and economic performance in Sub-Saharan Africa.

Theoretical framework

Endogenous Growth Theory*:* Endogenous growth happened due to forces engendered within the economic system and not otherwise. It can also be referred to as growth emanating from the actions of the economic agents within a particular economic system. Even technological change is the outcome of the actions of profit maximizing economic agents.

Paul Romer introduced the endogenous growth theory in the late 1980s, with his seminal work published in 1986 and further elaborated in the early 1990s. This model marked a shift from traditional neoclassical growth models, such as the Solow-Swan model, which attributed technological progress and economic growth to external factors (Romer, 1990). Endogeneity of Technological Change; Role of Knowledge and Ideas; Spillover Effects and Non-Diminishing Returns to Knowledge are the components of the Romer's model. According to Romer, investments in human capital, including health, are key drivers of economic growth. Health expenditure plays a vital role in enhancing productivity, increased health expenditure improves population health, reducing absenteeism and increasing labor productivity. A healthier workforce is better equipped to engage in research, learning, and innovation, which are critical to sustaining growth in Romer's framework. In Sub-Saharan Africa, where health challenges are significant, higher health expenditure represents a direct investment in human capital that aligns with Romer's emphasis on endogenous growth (Romer, 1990).

Labour productivity are key mechanisms through which human capital contributes to growth in Romer's model. Health inequality affects these areas by reducing workforce participation when poor health disproportionately affects the ability of individuals to participate in the labor force, leading to lower economic output after its lower productivity levels when workers with poor health are less productive, and high inequality in health outcomes exacerbates this issue across sectors. In Sub-Saharan Africa, health inequality limits the effective utilization of the labor force, which in turn reduces the rate of knowledge accumulation and economic growth potential as outlined in Romer's framework (Romer, 1990).

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3.0 METHODOLOGY

Research design

This study will adopt a longitudinal research design, leveraging on panel data to investigate the relationship between health outcomes and economic performance across Sub-Saharan Africa from 1990 to 2022. The data for this paper was obtained from secondary sources.

Model Specification

To achieve this objective, which seeks to evaluate the impact of health inequality on labour productivity in Sub-Saharan Africa, the study adopted the model of Olorunfemi and Adeoye (2020)

The functional form of the equation is given as:

$$LPR_{it} = f(HIQ_{it}, HEX_{it}, GDP_{it}, POP_{it}) \quad (3.0)$$

Hence, the estimated Model is specified in equation (17)

Bounds Test for Cointegration Equation

$$LPR_{it}=0+\sum_{j=1}^{p}1LPR_{i,t-j}+\sum_{j=0}^{q}2HIQ_{i,t-j}+\sum_{j=0}^{q}3HEX_{i,t-j}+\sum_{j=0}^{q}4GDP_{i,t-j}+\sum_{j=0}^{q}5POP_{i,t-j}+1LPR_{i,t-1}+2HIQ_{i,t-1}+3HEX_{i,t-1}+4GDP_{i,t-1}+5POP_{i,t-1}+i+it \quad (3.1)$$

Long-Run Equation

Since it was confirmed that cointegration exist in the model, the long-run relationship is:

$$LPR_{it}=0+1HIQ_{it}+2HEX_{it}+3GDP_{it}+4POP_{it}+i+it \quad (3.2)$$

Short-Run Equation (ECM)

$$LPR_{it}=0+\sum_{j=1}^{p}1LPR_{i,t-j}+\sum_{j=0}^{q}2HIQ_{i,t-j}+\sum_{j=0}^{q}3HEX_{i,t-j}+\sum_{j=0}^{q}4GDP_{i,t-j}+\sum_{j=0}^{q}5POP_{i,t-j}+\phi ECM_{i,t-1}+i+it \quad (3.3)$$

Error Correction Term (ECT)

$$ECM_{i,t-1}=LPR_{i,t-1}-1HIQ_{i,t-1}-2HEX_{i,t-1}-3GDP_{i,t-1}-4POP_{i,t-1} \quad (3.4)$$

Where:

LPR_{it}= Labour productivity

HIQ_{it}= Health inequality

HEX_{it} = Health expenditure

GDP_{it}= GDP per capita

POP_{it}= Population

$Ɛ_{it}$ = Error term

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Technique of analysis

This study employs panel econometric techniques to examine the long-run and short-run relationships among health inequality, macroeconomic variables, and development outcomes in Sub-Saharan Africa. Given the dynamic nature of the relationships and the mixed order of integration of the variables, the Panel Autoregressive Distributed Lag (Panel ARDL) model using the Pooled Mean Group (PMG) estimator is adopted as the main estimation technique.

Variables and Measurement

Variable	**Notation**	**Measurement**
Real GDP	RGDP	Annual growth rate of real GDP (inflation-adjusted)
GDP per capita	GDP	GDP per capita growth rate (% annual)
Life expectancy	LEX	The average number of years a newborn is expected to live (*life expectancy at birth total*)
Health expenditure,	HEX	Total health expenditure as % of GDP
Health inequality.	HIQ	Concentration index
Labour productivity	LPR	Labor force participation rate (% of working-age population)
Under five mortalities	UNM	Number of deaths of children under 5 years of age per 1,000
Education expenditure	EDU	Government education expenditure as % of GDP
Air pollution	POLL	Carbon dioxide emission
Population	POP	Annual population growth rate (%)
Institutional quality	INQ	Control of Corruption
Investment	INV	Gross fixed capital formation (% of GDP)

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4.0 RESULTS AND DISCUSSIONS

Descriptive Analysis of the Model (Impact of Health Inequality on labour productivity)

Table 4.1 Descriptive Analysis of the variables (1990-2022)

	LPR	HIQ	HEX	GDP	POP
Mean	19385.26	41.80735	59.21100	239.0998	16060972
Median	9893.016	40.80000	21.13278	1.691718	6226773.
Maximum	138860.3	71.10000	1232.375	9159.257	2.23E+08
Minimum	479.5200	2.400000	-3832.625	-44.55225	375428.0
Std. Dev.	25411.59	9.091390	238.0888	1349.604	30035138
Skewness	2.578335	0.311142	-8.811367	5.561750	4.038285
Kurtosis	9.862468	3.607481	131.7884	32.23755	21.40617
Jarque-Bera	3343.444	34.31576	766701.5	44402.46	18332.32
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	21110552	45528.20	64480.78	260379.7	1.75E+10
Sum Sq. Dev.	7.03E+11	89926.86	61674666	1.98E+09	9.81E+17
Observations	1089	1089	1089	1089	1089

Source: Authors computation using Eviews 10, 2026.

Table 4.1 shows that Labour productivity (LPR) has the mean of 19385.26 participation rate, median value of 9893.016 participation rate, the maximum participation rate of 138860.3 and minimum participation rate of 479.5200. Labour productivity has a standard deviation of 25411.59, Skewness of 2.578335 and Kurtosis of 9.862468.

Health inequality (HIQ) has the mean value of 41.80735 level on inequality, median value of 40.80000 level of inequality. The maximum value for health inequality in

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Sub-Saharan Africa is 71.10000, while the minimum is 2.400000 level of inequality. It has a standard deviation of 9.091390, Skewness of 0.311142 and Kurtosis of 3.607481

Health expenditure (HEX) across the region deviate considerably with a mean of 59.21and a median of 21.13 indicating that only few countries with a very high health expenditure greatly influenced the average. A substantial disparity in health spending in the region was indicated by the large standard deviation of 238.09.

The average value of per capita GDP proxied by (GDP) is 239.0998 annual growth rate and the median is 1.691718 annual growth rate. The maximum is 9159.257 annual growth rate and the minimum is -44.55225 annual growth rate. The standard deviation is 1349.604, while the Skewness is 5.561750 and Kurtosis is 32.23755

The mean value of population (POP) is 16,060,972 annual population growth while the median is 6,226,773 annual population growth indicating many countries population are below the average because of few large countries in the sub region. The maximum population is 223 annual population growth and the minimum is 375,428 annual population growth respectively which demonstrated a significant dispersion in the population size in Sub-Saharan Africa. The standard deviation is 30,035. The distribution of population in the region is passively skewed. The kurtosis is 21.41.

Correlation Analysis

Table: 4.2 Correction Analysis test Result

	LPR	HIQ	HEX	GDP	POP
LPR	1.000000				
HIQ	-0.052079	1.000000			
HEX	0.189969	0.184768	1.000000		
GDP	0.037798	0.000542	-0.020510	1.000000	
POP	-0.164365	-0.146605	-0.062292	-0.070923	1.000000

Source: Authors computation using Eviews 10, 2026.

The correction analysis in Table 4.2 indicates that labour productivity (LPR) has a weak negative correlation with health inequality (HIQ) -0.052079. On the contrary, labour productivity (LPR) has a positive correlation with health expenditure (HEX) 0.189969. Similarly, labour productivity has a positive correlation with per capita GDP (GDP)

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0.037798. But labour productivity (LPR) has a negative correlation with population (POP) -0.164365. There is a positive correlation between health inequality (HIQ) and health expenditure (HEX) 0.184768. Similarly, health inequality (HIQ) has a weak positive correlation with per capita GDP (GDP) 0.000542, but has a negative correction with population (POP) -0.146605. Health expenditure (HEX) has a weak correlation with per capita GDP (GDP) and population (POP) with -0.020510 and -0.062292 respectively. Per capita GDP (GDP) has a negative correlation with population (POP) -0.070923.

Lastly, population (POP) has a negative correlation with all other variables in the distribution. Population has a negative association with labour productivity (LPR), health inequality (HIQ), health expenditure (HEX) and per capita GDP (GDP).

Panel Unit Root Analysis

The test of stationarity condition for each of the variables is a necessary condition before the estimation of the panel Autoregressive Distributed Lag (ARDL) estimation technique. This is necessary to prove that the variables have met the condition for the ARDL estimation which is for the variable to be a mix of I(0) and I(1) variables. In this study, the Im Pesaran and Shin as well as the Levin Lin and Chu panel unit root tests were used for testing the unit root properties of the panel data modelled in the study. The results of the panel unit root analysis are presented in Table 4.3

Table 4.3: Results of Levin Lin and Chu and Im Pesaran-Shin panel Unit Root Test

Levin Lin and Chu panel Unit Root Test					
Variables	**Statistics**	**Prob.****	**Statistics**	**Prob.****	**Stationarity**
GDP	-7.31614	0.0000	-	-	I(0)
HEX	6.13527	1.0000	13.0952	0.0000	I(1)
LPR	7.64262	1.0000	-16.2703	0.0000	I(1)
POP	1.87270	0.9694	-3.14329	0.0008	I(1)
HIQ	4.35836	0.0000	-	-	I(0)
Im Pesaran-Shin panel Unit Root Test					
Variables	**Statistics**	**Prob.**	**Statistics**	**Prob.**	**Stationarity**
GDP	-12.5869	0.0000	-	-	I(0)
HEX	5.42154	1.0000	15.5488	0.0000	I(1)

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LPR	6.71304	1.0000	-16.1612	0.0000	I(1)
POP	11.7297	1.0000	-9.89197	0.0000	I(1)
HIQ	5.27285	0.0000	-	-	I(0)

Source: Authors computation using Eviews 10, 2026

Based on the results of the Levin-Lin and Chu and Im Pesaran and Shin panel unit root test presented in Table 4.3, the results present varying results based on the stationarity of the panel data. However, the variables have are a mix of I(0) and I(1) as can be observed from the results. For instance, per capita GDP (GDP) and health inequality (HIQ) were found to be stationary at level) based on the Levin-Lin and Chu pane unit root results and Im Pesaran and Shin panel unit root test while health expenditure (HEX), labour productivity LPR) and population (POP) were stationary after first differencing I(1).

Table 4.4 Bound test for the model

ARDL bound test of co-integration						
Lag =2	F-statistics = 5.976462*					
Critical Value Bound of the F-statistics						
K	5%		2.5%		1%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
4	2.56	3.49	2.88	3.87	3.29	4.37

Note: * implies that computed f-statistics is above upper bound values

Source: Authors computation using Eviews 10, 2026

Table 4.4 presents result of ARDL bound testing co-integration approach for electricity consumption equation. The first step in this technique is to compare result of calculated f-statistic with it critical values given in the study of Pesaran, Shin & Smith, (2001). Consequently, f-statistic of 5.976462 which is calculated at k=4 (number of independent variable) exceeds the upper critical value at 5 per cent, 2.5 per cent and 1 per cent. Therefore, null hypothesis of no co-integration was rejected without considering whether they are integrated of the same order or not. Thus, it was concluded that long run relationship exists among the variables at 5% level of significance.

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Table 4.5 ARDL regression Results Long run form

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
HIQ	-2786.762	1671.495	-1.667227	0.0463
HEX	-304.0324	159.9370	-1.900951	0.7580
GDP	12339.97	7330.138	1.683457	0.0931
POP	0.008258	0.004345	1.900509	0.0581

Source: Authors computation using Eviews 10, 2026.

The ARDL results in Table 4.5 indicates that health inequality (HIQ) has a negative coefficient of -2786.762 and it is statistically significant at 5% level. This suggests that increase in health inequality leads to a significant reduction in labour productivity in Sub-Saharan Africa in the long run. This finding is consistent with Human Capital Theory which buttress that population health is very essential to the growth and performance of an economy. In theory this finding indicates that disparities in health indicates that a large segment of the population suffer from poor health thereby reducing the efficiency and productivity of the entire labour force.

Similarly, the long run coefficient of health expenditure (HEX) -304.0324 is negative but not statistically significant at 5% level. This suggest that the coefficient though negative is not capable to influencing labour productivity in the long run in Sub-Saharan Africa. It also implies that health budget is not actually health spending. Many economies may allocate certain amount of fund for health sector and not actually spent that amount.

The coefficient of perc capita (GDP) 12339.97 in the long run in Sub-Saharan Africa is positive but not statistically significant at 5% level. This indicates that higher level of per capita output has a positive effect on labour productivity (LPR), but has no meaningful impact on labour productivity in the long run in Sub-Sharan Africa.

Lastly, the long run coefficient of population (POP) 0.008258 is positive and statistically significant at 5% level. This implies that population increase contributes positively to labour performance though consistent with Endogenous Growth Theory, the impact is small. It also indicates that growing population tends improve productivity in the long run which can eventually leads to economies of scale. Some of the empirical studies (Ugeh et al., 2025; Teuta et al., 2020; Ozyilmaz et al., 2022) confirm a positive relationship between health expenditure and economic growth or productivity, showing that higher spending improves human capital and long-run performance. However, a few studies (Serif & Mustafa, 2021; Olayiwola et al., 2021) revealed a weak or no causal relationship,

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suggesting that the effect of health expenditure may vary across countries depending on efficiency of the institutions.

Table 4.6 Results of the Error Correction Mechanism (ECM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
COINTEQ01	-0.002976	0.004049	-0.734955	0.0428
D(LPR(-1))	0.260635	0.099578	2.617395	0.0092
D(HIQ)	90.67395	132.9333	0.682101	0.4956
D(HIQ(-1))	-91.61311	83.42260	-1.098181	0.2728
D(HEX)	-24.03595	27.79854	-0.864648	0.3878
D(HEX(-1))	-13.33774	15.74413	-0.847156	0.3974
D(GDP)	153.3583	96.86984	1.583138	0.1142
D(GDP(-1))	41.87411	25.36474	1.650879	0.0996
D(POP)	-0.041587	0.128109	-0.324618	0.7456
D(POP(-1))	0.079234	0.301435	0.262856	0.7928
C	1026.023	1515.367	0.677079	0.4988
Mean dependent var	250.7480	S.D. dependent var		7154.484
S.E. of regression	4381.983	Akaike info criterion		11.19065
Sum squared resid	7.53E+09	Schwarz criterion		14.38636
Log likelihood	-5396.307	Hannan-Quinn criter.		12.40020

Source: Authors computation using Eviews 10, 2026.

Table 4.6 shows that the error correction term is negative and significant (-0.003) indicating that short-run deviations from equilibrium are corrected very slowly, with only about 0.3% adjustment per period. The short-run coefficient of one period lagged of labour productivity (LPR) is positive and statistically significant at 5% level. But the coefficient of health inequality (HIQ) and the one period lagged are not significant in the short-run at 5%

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level. Similarly, the short-run coefficient of health expenditure (HEX), GDP per capita (GDP) and population (POP) and their one period lagged are not statistically significant at 5% level.

Diagnostic Tests of the Estimated Model in Impact of health expenditure on Economic growth in Sub-Saharan Africa

These tests were conducted in other to examine the estimated model satisfy the Classical Linear regression assumptions.

Breusch-Godfrey Serial Correlation LM Test

F-statistic	4.659981	Prob. F(2,7)	0.1517
Obs*R-squared	16.56125	Prob. Chi-Square(2)	0.7603

Source: Authors computation using Eviews 10,2026.

The Breusch-Godfrey Serial Correlation test indicates that there is no serial correlation in the model residuals. The F-statistic of 4.659981 and probability value of 0.1517 and an Obc*R-squared of 16.56125 and probability of 0.7603 which greater than 5% level of significant. Therefore, since the probability is greater than 5%, the null hypothesis of no serial correlation cannot be rejected.

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.467163	Prob. F(19,9)	0.2835
Obs*R-squared	21.92224	Prob. Chi-Square(19)	0.2881
Scaled explained SS	1.482263	Prob. Chi-Square(19)	1.0000

Source: Authors computation using Eviews 10,2026.

The Breusch-Pagan-Godfrey heteroskedasticity test was conducted to show whether the variance of the residuals is constant. The results indicates that the model does not suffer from homoscedasticity since the probability values is greater than 5% level of significance. With the F-statistic of 1.467163 and probability of 0.2835 and Obs*R-squared of 21.92224 with Chi-square probability of 0.2881, the null hypothesis of heteroskedasticity cannot be rejected. Hence, the model has no evidence of Heteroskedasticity.

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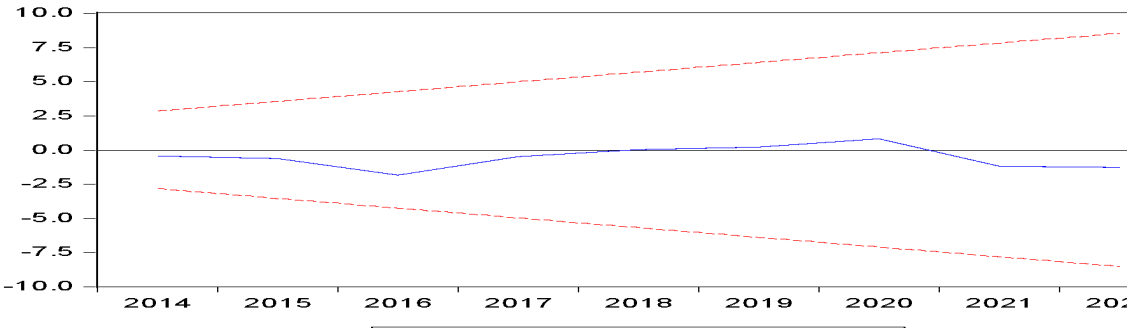
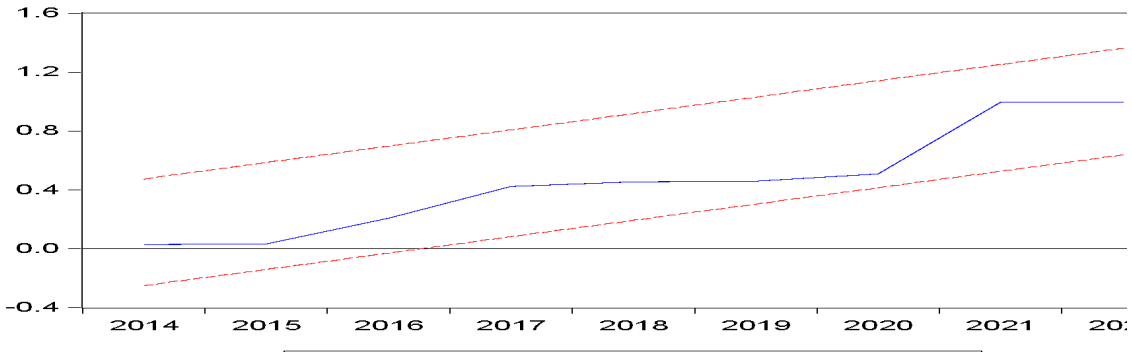
Figure 1: Cusum test



This was conducted to determine whether the parameters of the model are stable over the study period. The graphical results in Figure 4.5 suggests that Cusum line lies within the critical bound at 5% throughout the period of the study. This indicate that estimated coefficient of the model is stable with no evidence of structural instability.

Figure 2 Cusum of Sqaures



The graph shows that the Cusum of squares line lies within the critical bound of 5% indicating that the estimated coefficients of the model are stable with the period of study.

5.0 CONCLUSION AND RECOMMENDATION

This study examines the impact of health inequality on labour productivity in Sub-Saharan Africa using Panel ARDL across 46 Sub-Saharan African countries. The findings revealed that health inequality and health expenditure has a negative relationship with labour productivity in the sub region, while population (POP) has a positive relationship with labour productivity in Sub-Saharan Africa. In conclusion, the study established that health inequality and health expenditure exert a negative influence on labour productivity in Sub-Saharan Africa, implying that disparities in health outcomes and inefficiencies in healthcare spending may hinder workers' productive capacity within the region. Conversely, population growth was found to positively influence labour

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productivity, suggesting that a larger population may contribute to increased labour supply and economic activity when effectively utilized

The study recommends that there should be a designed and implemented multi-level health equity policies that clearly target disparities in access, quality, and health outcomes across income groups, geographic locations, and gender. At the community level, this includes expanding primary healthcare facilities, mobile clinics, and outreach services in rural and hard-to-reach areas. At the household level, policies such as subsidized or free healthcare for low-income populations, social health insurance schemes, and conditional cash transfer programs should be strengthened to reduce financial barriers to care.

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