Innovations

# Health Outcomes, Poverty and Economic Growth In Sub-Saharan Africa: A Cross-Sectional Augmented Autoregressive Distributed Lag Approach

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**Abstract**

*The relationship between health outcomes and economic growth, though widely debated is far from being settled, and this inconclusiveness may be partly explained by the high levels of poverty and low living standards which is pervasive in the continent. Studies have proposed that the presence of poverty could serve to moderate the impact of improved health outcomes on economic growth. This study seeks to investigate how health outcomes and poverty influence economic growth in sub-Saharan Africa. Cross-sectional augmented autoregressive distributed lag (CS-ARDL) approach is utilized to ascertain the short and long-run impact of life expectancy, infant mortality, and economic discomfort index on the growth of per capita GDP in SSA countries in the presence of cross-sectional dependence. A robustness and consistency analysis of the CS-ARDL estimates also employs a complementary framework, the cross-sectional augmented distributed Lag (CS-DL) technique. The results of the study indicate that the combined influence of infant mortality and poverty causes economic growth to deteriorate in the region. Interestingly, the interaction of life expectancy and economic discomfort index is shown to be positively and significantly related to economic growth in the short run, but in the long run, it becomes negatively related to economic growth. This study concludes that over time the persistence of poverty in SSA countries erodes the benefits of improved life expectancy, and invariably exerts an adverse effect on economic growth. Thus, there is an urgent need to address the menace of widespread poverty and poor health outcomes in the region.*

**Keywords: 1.** *Life expectancy 2. Economic discomfort index 3. Per capita gross domestic product 4. cross-sectional augmented autoregressive distributed lag.*

## 1. Introduction

The sub-Saharan African (SSA) region has witnessed weakeconomic performance manifested in high unemployment, low standard of living as well as high poverty in the last two decades. Unemployment in SSA is estimated at 30.1 million of the working population in 2018; and the region has the second highest figure in the world, only next to Southern Asia with 30.2 million unemployed persons (ILO, 2007).The per capita income for the region averaged $3,691 between 2010 and 2018, lower than that of all other developing regions and about one-fifth the size of Latin America and the Caribbean region (World Bank, 2018). Poverty and poor health conditions including low life expectancy and rising infant mortality rates hinder Africa's productivity and by extension her growth and development. Although Africa is endowed with rich human and natural resources, most ofits people are poor and live below acceptable economic standards. Statistics reveal that the percentage headcount ratio for SSA was 41.0 in 2017 and 42.3 in 2018 compared to that of South Asia-14.7 and 15.1; Latin America and the Caribbean-4.9 and 4.5; East Asia and the Pacific-3.7 and 3.6; the Middle East and North Africa-2.3 and 2.7 for the same period. In terms of the number ofpoor in these regions, SSA also takes the lead with 390 million and 401 million in 2017 and 2018, respectively compared with South Asia, 241 million and 257 million; Latin America and the Caribbean,30.1 million and 27.8 million; East Asia and the Pacific,73.9 million and 73.2 million, and the Middle East and North Africa,8.3 million and 9.6 million for the same period, respectively (World Bank, 2018).

The life expectancy for SSA in 1980 was as low as 48 years compared to that of Latin America/the Caribbean and East Asia/the Pacific which was 64 years. While both Latin American and East Asian regions succeeded in improving life expectancy to 75 and 74 years, respectively in 2015, SSA lagged at 58 years. The indices for infant and maternal mortality in SSA have not fared better either. In 1980, the infant mortality rate per 1,000 live births was 53, 64, 87, and 110 for East Asia/the Pacific, Latin America/the Caribbean, the Middle East/North Africa, and sub-Sahara Africa, respectively. However, by 2015 while the other regions witnessed a marked reduction in the infant mortality rates to 14, 15, and 20 for East Asia, Latin America, and the Middle East, respectively; that of SSA could only drop to 56 which was still higher than the figure of East Asia, thirty-five years before 2015. Also, in 1980, the maternal mortality ratio for SSA was quite high at 987 with a marginal reduction to 547 in 2015 which is far higher than the ratio for other developing regions in1980 which stood at 159, 135, and 166 for East Asia, Latin America and the Middle East, respectively. By 2015, the tide had turned in a dramatic manner for these regions with the figure for East Asia and Latin America estimated to be 59 and 67 while that of the Middle East was 81(WDI, 2017).

Moreover, sluggish economic growth in 2016 was also witnessed in many SSA countries such as Nigeria (-2.06), Botswana (-1.3%), Rwanda (-1.4%), Senegal (-2.5%), and Namibia (-6.2). In the second quarter of 2018, the South African economy, the most developed economy within the SSA region also recorded a poor growth rate of 0.7% that plunged the country into recession, with the unemployment rate put at 27%(Toyana and Chalumbira, 2018; Tule *et al.*, 2018). Improving economic growth in SSA has not only become a prerequisite for development but also an objective in its own right thatis essential to enhancing the people's living standards. Studies have shown that sound health status measured by improved life expectancy and reduced mortality rates are important factors that could facilitate robust economic growth(Tekabe, 2012; Sarpong *et al*., 2018). More so,poverty reduction is regarded as an important component of improved health and a key determinant of economic growth(Sahn, 2012).

Extant literature on the effect of health on economic growth in Africa have reported mixed conclusions,this has also opened a new vista in research on what could be the intermediary variables influencing this relationship.Tekabe (2012)reported that healthhas a significant negative relationship with mortality rates and per capita growth. Also, Ogunleye (2014) argued that health indices such infant mortality and life expectancy do not have significant effect on economic growth in the region. However,Sarpong *et al*. (2018) foundthat health is a significant determinant of long run economic growth in the SSA. Other studies within and outside the sub region have reached debates about these mixed conclusions have as well been reported byAguayo-Rico, (2005) and Subramanian&Corsi (2014).

The relationship between health outcomes and economic growth, though widely debated(Sahn, 2012; Tekabe, 2012; Ogunyele, 2014; Sarpong *et al.,* 2018; Tule *et al.,* 2018*)* is far from being settled, and this inconclusiveness may be partly explained by poverty related indices which serve to moderate the impact of health outcomes on economic growth.This paper therefore empirically examines the modifying effect of poverty on health outcomes proxy by life expectancy and infant mortality rates on economic growth in sub-Saharan Africa (SSA). From this study, it is expected that new research evidence and policy outcomes will emerge on how the growth trajectory in the region can be improved through good health statusand enhancedliving standards. Also, Cross Sectional Augmented Autoregressive Distributed Lag (CS-ARDL) in this study, withits complementary framework to check for the robustness and consistency of the CS-ARDL estimates.

The rest of the paper is structured as follows. Section 2 contains the review of extant literature on the impact of health outcomes and poverty on economic growth; the methodology and estimation techniques are found in section 3; the results of the study are captured in section 4; and section 5 discusses the findings and policy implications of the study, while section 6 concludes the study.

## 2. Research methodology

### Empirical Model

The models for the panel regression are specified in two separate equations. The first equation contains models 1,2, and 3 that depict the effect of life expectancy and poverty on economic growth. The second equation has models 4,5, and 6that capture the impact of infant mortality and poverty on economic growth. The first model in each of the equations is considered the baselinemodel,and it depicts how economic growth responds to variations in the independent variables, while excluding the poverty variable. The second model includes the economic discomfort index (poverty) as one of the independent variables, and the third model incorporates an interactive variable, a combination of the economic discomfort index and the heath outcome.

**Economic Growth – The Role of Life Expectancy and Poverty**

**Model 1**

$LPCGDP_{it} = f(POPGR_{it},\ LGFCF_{it},\ LEXP_{it})$1

**Model 2**

$LPCGDP_{it} = f(POPGR_{it},\ LGFCF_{it},\ LEXP_{it}, DCI_{it})$ 2

**Model 3**

$LPCGDP_{it} = f(POPGR_{it},\ LGFCF_{it},\ LEXP_{it}, DCI_{it}, LEXP_{it} * DCI_{it})$3

**Economic Growth – The Role of Infant Mortality and Poverty**

**Model 4**

$LPCGDP_{it} = f(POPGR_{it},\ LGFCF_{it},\ INFM_{it},)$4

**Model 5**

$LPCGDP_{it} = f(POPGR_{it},\ LGFCF_{it},\ INFM_{it}, DCI_{it})$5

**Model 6**

$LPCGDP_{it} = f(POPGR_{it},\ LGFCF_{it},\ LEXP_{it}, DCI_{it}, INFM_{it} * DCI_{it})$6

**Study variables/Data**

The variables used in the study are LPCGDP which is the logarithm of per capita Gross Domestic Product as a measure for economic growth in sub-Saharan Africa (SSA). The health outcome variables are LEXP which indicates life expectancy at birth and it portrays the number of years a newborn child would live provided certain patterns of living at the time of delivery were to be unchanged or improved; INFM (infant mortality rate) is the number of infants that die annually per 1,000 live births. The control variables are; POPGR connotes the population growth rate for the countries; LGFCF represents the logarithm of Gross Fixed Capital Formation (formerly referred to as Gross Domestic Fixed Investment) which comprises land improvements, plants, equipment purchases, machinery, and other construction activities; and DCI is economic discomfort index, a measure of poverty obtained by summing unemployment rate and inflation rate as advanced by (Okun, 1962). L represents the log of the variable while the subscript "it" represents country i at time t. The data for the variables were generated from the World Bank, World Development Indicator (2020). The analysis covers 1991 to 2017, and 30 countries are selected from sub-Saharan Africa based on data availability.

**Estimation Technique**

The tendency for unobserved common factors to influence the outcomes of macro panel data analysis has raised serious concerns in emerging extant literature. In order to mitigate the derailing effects of this contemporaneous correlation, Pesaran (2004) proposed the cross-section dependence (CD) test. By employing the CD test in this study, we attempt to ascertain the existence or otherwise of cross-sectional dependence across sub-Saharan Africa (SSA). The test is also relevant in identifying the most appropriate panel-unit-root test to conduct as well as the best co-integrating procedure to be utilized. The underlining test equation for the cross-section dependence is expressed as:

$$CD = \sqrt{\left(\frac{2}{N(N-1)}\right)}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\sqrt{T_{ij}\hat{\rho}_{ij}}\right) \qquad CD \sim N(0,1) \qquad 15$$

Where N is the number of cross-sectional units; T represents the time dimension; and $\hat{\rho}_{ij}$ connotes the pairwise cross-sectional correlation coefficient of the augmented Dickey-Fuller (ADF) regression residuals. The null hypothesis of the CD test is that there is cross-sectional independence against its alternative of cross-sectional dependence among units.

Envisaging the presence of CD across SSA countries because of their peculiar economic features, we adopt the Pesaran(2007) panel-unit-root approach, otherwise called the cross-sectional augmented, Im, Pesaran and Shin (CIPS) technique in this study. This second-generation panel unit root test combines the cross-sectional augmented Dickey-Fuller (CADF) approach and the Z(t-bar) test developed by (Im, Pesaran and Shin, 2003). The CADF test equation is as follows:

$$\Delta y_{it} = \varphi_i + \beta_i y_{it-1} + c_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t + u_{it} \qquad 16$$

Where t = 1, …,T, and i = 1,…,N. $\bar{y}_t = \frac{1}{N}\sum_{j=i}^{N} y_{jt}$ is the proxy for the unobserved common factor, and its lagged component(s), $\bar{y}_{t-1}$, $\bar{y}_{t-2}$,…. The purpose is to fundamentally filter out the effects of contemporaneous correlation across the sample countries. The null and alternative hypotheses are:

$H_0 : \beta_i = 0$, for all i

$H_1 : \beta_i < 0$, for i= 1, 2, …, $N_1$; $\beta_i = 0$, i = $N_1 + 1$, $N_1 + 2$, …, N.

The cross-sectionally augmented version with the IPS test statistic of [33] is:

$$CIPS(N,T) = t - bar = \frac{1}{N}\sum_{i=1}^{N} t_i(N,T) \qquad 17$$

Where $t_i(N,T)$ is the CADF statistic for the ith unit obtained using the t-ratio of $\beta_i$ in the CADF test equation. Moreover, Chudik *et al.* (2015) argue that the ability of CS-ARDL to address unobserved common effects and produce asymptotically unbiased outcomes makes the framework particularly exceptional for this kind of study. Importantly, CS-ARDL captures the dynamic behaviour of series under an error correction mechanism; and thus, provides both short- and long-run coefficients. The CS-ARDL framework is presented as:

$$\Delta y_{it} = \eta_i + \psi_i (y_{it-1} - \varphi_i x_{it-1} - \omega_{1i} \bar{y}_{t-1} - \omega_{2i} \bar{x}_{t-1}) + \sum_{j=i}^{q-1} \gamma_{ij} \Delta y_{it-j} + \sum_{j=0}^{p-1} \phi_{ij} \Delta x_{it-j} + \lambda_{1i} \Delta \bar{y}_t + \lambda_{2i} \Delta \bar{x}_t + u_{it} \quad 18$$

$y_{it}$ (LPCGDP) indicates the dependent variable; $\eta_i$ is the constant term; $\psi_i$ represents the speed of adjustment from short-term disequilibrium to long-term convergence; and $\varphi_i$ connotes the slope coefficients of the regressors (key and control variables). Also, while $\bar{y}_{t-1}$ and $\bar{x}_{t-1}$ depict proxies for the unobserved common factors, particularly in the long run, $\Delta \bar{y}_t$ and $\Delta \bar{x}_t$ account for the contemporaneous correlation effects in the short run.

A novel addition to the extent literature in the application of the CS-ARDL is the use of its complementary framework (CS-DL) to conduct a robustness check on the CS-ARDL estimates for this study. As proposed by (Chudik *et al.*, 2015), the CS-DL test equation is

$$\Delta y_{it} = \eta_i + \psi_i y_{it-1} + \varphi_i x_{it-1} + \sum_{j=i}^{q-1} \gamma_{ij} \Delta y_{it-j} + \sum_{j=0}^{p-1} \phi_{ij} \Delta x_{it-j} + \sum_{j=0}^{q-1} \lambda_{1i} \Delta \bar{y}_t + \sum_{j=0}^{p-1} \lambda_{2i} \Delta \bar{x}_t + u_{it} \quad 19$$

The CS-DL approach is robust for examining the presence of any breaks in the error term that may lead to biased CS-ARDL outcomes. As a complementary estimation technique to the CS-ARDL approach, we adopt the CS-DL technique to check whether by imposing CS-DL pooled estimator of the long-run coefficient can substantially improve the short-run estimates of the CS-ARDL.

# 3. Empirical results

## 3.1 Descriptive Statistics

The empirical analysis for this study begins with the consideration of its descriptive statistics to appreciate the overall behaviour of the panel series as reported in Table 1.

**Table 1 Descriptive summary statistics**

| Variable | Mean | Std. Dev. | Min | Max | Obs |
|---|---|---|---|---|---|
| LPCGDP | 6.4991 | 1.0093 | 4.7178 | 9.2868 | 810 |
| POPGR | 2.5700 | 0.9520 | -6.7662 | 8.1179 | 810 |
| LGFCF | 20.901 | 1.6463 | 14.4886 | 25.1747 | 810 |
| LEXP | 54.2580 | 6.4178 | 26.172 | 68.812 | 810 |
| INFM | 73.2083 | 27.4160 | 28.2 | 158.3 | 810 |
| DCI | 16.6481 | 15.5542 | -67.972 | 161.753 | 810 |

**Source: Authors computation, 2023**

Table 1 above show on the average, the logarithm of per capita gross domestic product (LPCGDP) across SSA from 1991 to 2017 is $6.50, and varies widely between $4.718 and $9.29, respectively.The average population growth rate is 2.57 while the minimum and maximum values areestimated to be -6.77 and 8.12, respectively. As presented in Table 1, the average value of the logarithm of gross fixed capital formation (LGFCF) is $20.90, with a minimum of $14.49 and a maximum of $25.17. Life expectancy in SSA is 54 years on the average, while the minimum and maximum number of years a newborn child would live are 26 and 68 years, respectively. Furthermore, it is reported in Table 1 that the average number of young children that die per 1,000 live births is 73.21, with a minimum of 28.2 and a maximum of 158.3. Also, Table 1 reports that the average of the economic discomfort index for SSA is 16.65, with variability from -67.97 to 161.75 among SSA countries. Finally, infant mortality rate has the highest overall standard deviation value of 27.416, while population growth rate has the least value of 0.952. This implies that infant mortality rate in SSA countries exhibits the highest variability within the study period.

### 3.2Cross-sectional Dependence (CD) and 2nd Generation Panel Unit-root Tests

In a study such as this, it is pivotal to examine the presence or otherwise of contemporaneous correlation across SSA countries. Cross-sectional dependence can lead to a biased outcome if unobserved factors common to the sampled countries are not taken into account in a panel regression analysis (Pesaran, 2004).

**Table 2 Cross-sectional Dependence (cd) and 2nd Generation Panel Unit-root (cips) Test**

| | | | **CIPS** | | |
|---|---|---|---|---|---|
| **VARIABLE** | $\hat{\rho}$ | **CD** | **LEVEL** | **1st DIFFERENCE** | **I(d)** |
| LPCGDP | 0.808 | 87.58*** | -0.128 | -6.765*** | I(I) |
| POPGR | 0.501 | -0.13 | -1.129 | -4.278*** | I(1) |
| LGFCF | 0.823 | 88.97*** | -2.648*** | -6.535*** | I(0) |
| LEXP | 0.809 | 87.44*** | 5.176 | -6.983*** | I(1) |
| INFM | 0.924 | 100.16*** | -0.482 | -4.170*** | I(1) |
| DCI | 0.335 | 28.42*** | -1.393 | -14.302*** | I(1) |

Source: Authors computation, 2023

***Notes:* ***, **, * represent 1%, 5%, and 10% levels of significance, respectively. I(d) indicates the order of integration based on the 2nd generation panel unit-root test.**

The results in Table 2 above, report that infant mortality rate has the highest average pairwise correlation coefficients of the residuals ( $\hat{\rho}$ ) of 0.924, while the economic discomfort index has the least value (0.335). The resultin Table 2 therefore indicates that all the series manifests cross-sectional dependence problem except population growth rate. The presence of CD therefore necessitates an investigation into the unit-root properties of the panel series. Pesaran (2007) offers a second-generation panel unit-root test that combines the framework of cross-sectional augmented Dickey-Fuller (CADF) and Im *et al*. (2003) called CIPS Z(t-bar) test to carry out the unit-root test. This study employs the CIPS Z(t-bar) test incorporating a constant term. The underlined relevance of the CIPS test is that it applies the cross-sectional averages of CADF to each cross-sectional unit.The results of the panel unit-root test as shown in columns 4 and 5 of Table 2 reveal that while POPGR is stationary at level, LPCGDP, LGFCF, LEXP, DCI, and INFM become stationary after first difference. A mixed order of integration is thus created, a prerequisite for the application of Cross-Sectional Augmented Autoregressive Distributed Lag (CS-ARDL) approach.

### 3.3Economic growth in SSA: the role of life expectancy and poverty

To ascertain the role life expectancy and poverty plays in the dynamics of economic growth in SSA while incorporating other control variables, three models have been estimated as shown in Table 3. Particularly, the CS-ARDL estimation results for model 1 are treated as baseline estimation outcomes.

**Table 3 Economic Growth: The Role of Life Expectancy nd Poverty**

| Panel A | | | |
|---|---|---|---|
| D.V.: LPCGDP | Model 1 | Model 2 | Model 3 |
| Ecm | -0.3711*** | -0.3530*** | -0.3436*** |
| | (0.0431) | (0.0617) | (0.0550) |
| Short Run | | | |
| ΔPOPGR | -0.0261 | -0.1158 | -0.1101 |
| | (0.1546) | (0.1634) | (0.1708) |
| ΔLGFCF | 0.3384*** | 0.3220*** | 3.7380*** |
| | (0.0408) | (0.0394) | (0.0428) |
| ΔLEXP | 0.0723 | 0.0474 | 0.1556*** |
| | (0.0533) | (0.0548) | (0.0490) |
| ΔDCI | | -0.0032*** | -0.0310* |
| | | (0.0006) | (0.0161) |
| ΔLEXP*DCI | | | 0.0004* |
| | | | (0.0002) |

| Long Run | | | |
|---|---|---|---|
| POPGR | -0.0125 | -0.0039 | -0.0118 |
| | (0.0200) | (0.0158) | (0.2152) |
| LGFCF | 0.2139*** | 0.2153*** | 0.2170*** |
| | (0.0260) | (0.0234) | (0.0277) |
| LEXP | 0.0117*** | 0.0062* | 0.0184*** |
| | (0.0043) | (0.0036) | (0.0061) |
| DCI | | -0.0078*** | 0.0014 |
| | | (0.0008) | (0.0073) |
| LEXP*DCI | | | -0.0001 |
| | | | (0.0073) |
| Constant | 1.1985*** | -0.3282*** | -0.3059*** |
| | (0.1890) | (0.0919) | (0.0869) |
| Observations | 778 | 778 | 778 |
| Countries | 30 | 30 | 30 |

**Source: Authors computation, 2023**

***Notes:*** *****, **, * connote 1%, 5%, and 10%, levels of significance, respectively.**

As contained in Table 3 above , while model 1 shows how economic growth responds to variations in the independent variables when the unobserved common factors are accounted for without incorporating economic discomfort index as a control, model 2 captures panel regression outcomes when the CD bias is tackled, especially when a poverty instrument is introduced; and model 3 has the coefficients of estimation when such contemporaneous correlation effects are addressed in the presence of the control and an interaction between life expectancy and poverty, a unique contribution to the extant literature on the conceptualization of economic growth.The CS-ARDL estimates as reported in Table 3 show that the error correction component for all the models is highly significant. This shows that disequilibrium in the short run occasioned by external economic shocks is always adjusted to equilibrium in the long run. The estimated value of the error correction (EC) component ranges between -0.344 and -0.371. The implication of this result is thatconvergence in the long run occurs between 34.4 to 37.1 percent per annum, thereby validating the existence of a long-run relationship among the variables in the three models. The report further indicates that the baseline model(model 1) has the highest speed of adjustment towards long-run equilibrium (about 37.1 percent). Given that the speed of convergence towards the long-term relation is rather rapid, and the time dimension is sufficiently long, sampling uncertainty due to slower adjustment to the long run has been drastically reduced (Chudik *et al*., 2015).

Panel A results as reported in Table 3 shows that the coefficient of life expectancy (0.0723 and 0.0474) are positive but insignificant in promoting sustained economic growth both in the short and long term, except in model 3 where the introduction of economic discomfort index and the interaction between life expectancy and poverty reveals a positive and significant estimate (0.1556). The long-run estimates of life expectancy (0.0117, 0.0062 and 0.0184) in Table 3 have a positively significant impact on economic growth. The baseline coefficient of 0.0117 underscores the fact that 1year increase in life expectancy of SSA countries will cause economic growth to improve by 1.2 percent. Interestingly, the interaction of life expectancy and economic discomfort index is shown to be positively and significantly related to economic growth in the short run, but in the long run, it becomes negatively related to economic growth. The reports of models 2 and 3 in panel A in the short run indicate that the estimates of the economic discomfort index (-0.0032 and -0.0310) are negative and significant; and thus, causes a deterioration in growth. Basically, a unit increase in the poverty index will lead to fall in the log of per capita GDP of 0.032 and 3.1 percent, respectively. Model 1 shows that though the growth rate of population in SSA countries exerts adverse impact on economic growth, they are insignificant both in the short run and long run. The short- and long-run coefficient of the gross fixed capital formation in the baseline model and other models in Panel A (0.3384, 0.3220, 3.73) and (0.2139, 0.2153, 0.2170), respectively shows that this control variable is growth enhancing both in the short run and the long run, especially when the unobserved common factor bias is corrected. Model 3 shows that the contribution of gross fixed capital formation to economic growth is highest in the short run with a coefficient of 3.738. This implies that in the short term, a $1 increase in gross fixed capital formation will lead to about 3.73 percent increase in per capita gross domestic product of the sample countries in SSA.

### 3.4 Economic growth in SSA: the influence of infantmortality rate and poverty

Panel B in Table 4 reports that the error correction terms in the three models (models 4, 5, and 6, respectively) are less than one, negative and highly significant.

**Table 4 Economic growth: the role of infant mortality rate and poverty in Panel B**

| D.V.: LPCGDP | Model 4 | Model 5 | Model 6 |
|---|---|---|---|
| Ecm | -0.3674*** | -0.3148*** | -0.3167*** |
| | (0.0405) | (0.0427) | (0.0489) |
| Short Run | | | |
| ΔPOPGR | 0.2947* | 0.2438 | 0.3401* |
| | (0.1760) | (0.1755) | (0.2055) |
| ΔLGFCF | 0.4324*** | 0.4144*** | 0.4214*** |
| | (0.0376) | (0.0378) | (0.0377) |
| ΔINFM | -0.0228 | -0.0222 | -0.0171 |
| | (0.0159) | (0.0165) | (0.0158) |
| ΔDCI | | -0.0023*** | -0.0012 |
| | | (0.0006) | (0.0071) |
| ΔINFM*DCI | | | -0.0007 |
| | | | (0.0001) |
| Long Run | | | |
| POPGR | -0.0019 | 0.0009 | -0.0158** |
| | (0.0067) | (0.0096) | (0.0064) |
| LGFCF | 0.4078*** | 0.3739*** | 0.5344*** |
| | (0.0386) | (0.0422) | (0.0256) |
| INFM | -0.0012* | -0.0022* | -0.0025** |
| | (0.0011) | (0.0012) | (0.0011) |
| DCI | | 0.0033*** | -0.0141*** |
| | | (0.0012) | (0.0031) |
| INFM*DCI | | | -0.0002*** |
| | | | (0.0003) |
| Constant | -2.5028*** | -0.9427*** | -1.2684*** |
| | (0.2885) | (0.1414) | (0.2033) |
| Observations | 778 | 778 | 778 |
| Countries | 30 | 30 | 30 |

**Source: Authors computation, 2023**

***Notes:*** *****, **, and * indicate the levels of significance at 1%, 5%, and 10%, respectively.**

The values -0.3674, -0.3148, and -0.3167 show that the speed of adjustment to the long run for any short-run disequilibrium ranges from 31.5 percent to 36.7 percent. This implies that there is a rapid adjustment towards a co-integrating relation for temporary disequilibrium caused by exogenous economic shocks in the short run.Model 4 serves as the baseline, while models 5 and

6 in Table 4 present the detailed reports of the impact of infant mortality and poverty, as well as population growth rate and gross fixed capital formation on economic growth. The short run estimates of the infant mortalityrate ( -0.0228, -0.0222 and -0.0171) are not statistically significant while the estimates in the long term (-0.0012, 0.0022 and 0.0025) are found to have an increasingly negativeand significant impact on economic.The base model (model 4) shows that in the long run a unit increase in infant mortality rate will lead to economic growth plummeting by 0.12 percent. The introduction of the interacting variable increases the magnitude of the decline in economic growth following a rise in infant mortality by 0.25 percent; about 0.13 percent higher than that of the baseline. By comparing the baseline coefficient of INFM to the coefficients of models 5 and 6, we find that the incorporation of the poverty measure, as well as the combined impact of INFM and DCI amplifies the coefficient of the infant mortality rate. This implies that overtime, the number of newborns that die per 1,000 live births has a significant worsening effect on growth, especially in the face of poverty. This outcome is rather not surprising given that low infant mortality should signal an improvement in human capital development which is an essential ingredient to promoting sustained economic growth.The estimate of the combined influence of infant mortality rate and economic discomfort index is reported to be negative and insignificant especially inthe short but positive and significant in the long run though their impact on economic growth is highly infinitesimal.

**4. Discussion of Findings and Policy Implications**

The findings from the study show that in the short run improvements in life expectancy will lead to increased economic growth even in the face of poverty. Although, the interaction of life expectancy and economic discomfort index is shown to be positively and significantly related to economic growth in the short term,the effect of poverty on improved life expectancy is not instantaneous, henceits marginal contribution to economic growth. However, in the long term, the interaction becomes significant and inversely related to growth. This implies that over time economic discomfort inhibits economic growth within the region. This implies that overtime the persistence of poverty in the region will erode the supposed gains to SSA of improved life expectancy.The policy implication of this finding is akin to the report of (Sahn, 2012) who argued thatpoverty has a long-term deleterious impact on economic growth in SSA.

Although previous studies did not focus on the interface between poverty with life expectancy and their effects on economic growth, the empirical evidence of this study is supported by(Aguayo-Rico, 2005; Ogunleye, 2014) that life expectancy exerts a significant but negative effect on economic growth. These conclusions as pointed out in this study could have been influenced by widespread poverty in the region.Also, the harmful effect of infant mortality on economic growth may not be obvious in the short term, however over time, infant mortality exerts a significantly negative impact on economic growth.This is worsened by the prevalence of poverty; a conclusion consistent with the study by (Sahn, 2012; Ogunleye, 2014; Subramanian and Corsi, 2014) which reveals that a unit increase in per capita gross domestic product is associated with a reduction in infantmortalityrates. A decline in the number of children that die per 1,000 live births will evidentlyenhance the resourcefulness ofthe working-age population.

This study further finds thatin the long run, population growth in the presence of high infant mortality causes a progressive deterioration in economic activities. This implies that population growth accompanied with rising infant mortality would cause economic growth in SSA to decline by 15.8%. The findings indicate that though population growth may be a plausible outcome in the short run, an explosive population growth without improved health outcomes and human capital development will not be sustainable in the long run, rather it will have a plummeting effect on the growth of SSA economies. This research evidence corroborates the report of Olaniyan *et al*. (2018) that sub-Saharan African countries are yet to harness the demographic dividends that are associated with an increase in the working age population, and a decline in the dependent population.

Overall, while gross fixed capital formation and life expectancy enhance economic growth, infant mortality, the interaction between infant mortality and economic discomfort, population growth, economic discomfort as well as the interaction of life expectancy and economic discomfort deter economic growth in SSA countries during the period under consideration, especially in the long term. Moreover, the declining levels of output due to mortality and morbidity caused by the poor health status of the populace can result in huge consumption deficits, deprivations of welfare enhancing goods and reinforcement of the vicious cycle of poverty within the region.

## 5. Conclusion

This study examines the extent to which health outcomes and poverty influence economic growth in sub-Saharan Africa (SSA). CS-ARDL approach is employed to ascertain possible short-and long-term relations in the presence of cross-sectional dependence among the countries in SSA. The results of this study detail plausible research outcomes that call for more capital investments in economic activities that can enhance living standards and ameliorate widespread poverty in the region.Based on the findings of this study, there is an urgent need forsound health care systems, enhanced immunization coverage, sustained drive towardsa universal access to quality and affordable health care capable of increasing life expectancy and reducing infant mortality in the region. Also, there should be a measured policy response to the issues around population growth in SSA countries such that it does not compromise long-term economic growth. This can be achieved through access to quality health care and education at all levels, especially for the girl child.Drawing from the empirical evidence of this study, there is a clarion call for policy makers in SSA to address the menace of widespread poverty that has permeated the very core of the region. This can be achieved through the provision of credit to support entrepreneurial activities in the agriculture and manufacturing sectors. All these are essential to engendering sustainable economic growth in sub-Saharan Africa.

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