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Public Health Expenditure, Institutional Quality, and Economic Growth in Sub-Saharan Africa: Synergistic Dynamics Approach

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Abstract
This study investigates public health expenditure, institutional quality and economic growth in sub-Sahara Africa: A synergistic Dynamics Approach an ex-post facto research covering from 2000 to 2022, sourced from the World Bank Development Indicators and World Governance Indicators. The study adopted Pooled Mean Group Autoregressive Distributed Lag (PMG/ARDL) as an estimation technique. It was found that in isolation public health expenditure has negative impact on the growth, at the 5% level of significance, while it was equally observed that institutional quality has same negative on the growth at 1% significant level. But when combined they have positive impact on the growth of the economy at 1% significance level. At the same time, it was equally observed from the findings that, life expectancy demonstrated a positive impact on the growth at 1% level of significance, gross fixed capital formation exhibits positive impact at 5% statistically significant while trade openness contributes positive impact on economic at 1% all in the long-run. However, coming from the findings, the study therefore concludes, with the recommendations, that government should strengthen institutions by enhancing governance and of course reducing high level of corruption, so that there would be an improvement in public health expenditure and also implement policies to optimise and minimise mismanagement of public spending.

Keywords: Economic Growth; Institutional Quality; Public Health Expenditure; SSA
JEL Codes: **O47; *O17; I18; O43***

1. Introduction
Sub-Saharan Africa (SSA) faces persistent challenges in accomplishing sustainable economic growth and improving public health outcomes. With a median life expectancy of 66 years in 2021 compared to the global average of 74 years, and per capita health expenditure of just $92

against $379 in North Africa and the Middle East, SSA remains a region of stark health disparities (Apeagyei et al., 2024). Despite modest economic growth, averaging 3.5% annually from 2000 to 2015, health outcomes such as under-five mortality (U5M) and life expectancy at birth lag behind global benchmarks, underscoring the need for effective health financing and governance (World Bank, 2024). This study explores the synergistic dynamics among public health expenditure (PHE), institutional quality (IQ), and economic growth in SSA, positing that their interplay is critical for sustainable development.

Furthermore, public health expenditure in SSA is notably low, constituting only 34.4% of total health spending in 2015, compared to 59.7% globally (Micah et al., 2019). The Abuja Declaration of 2001 urged African nations to allocate 15% of their budgets to health, yet by 2013, only five countries met this target (World Health Organization, 2016). Studies indicate that PHE significantly enhances health outcomes, such as reducing U5M and increasing life expectancy, particularly when channeled through efficient systems (Novignon et al., 2012). However, the impact of PHE on economic growth is inconclusive, with some studies reporting positive effects (Bedir, 2016) and others finding no significant relationship (Eggoh et al., 2015). This inconsistency suggests that contextual factors, notably institutional quality, mediate the effectiveness of health spending.

Institutional quality, encompassing governance dimensions like control of corruption, rule of law, and government effectiveness, is pivotal in SSA, where weak institutions often undermine public spending efficiency. Research shows that in well-governed countries, PHE significantly reduces U5M, while in poorly governed ones, it has negligible impact (Rajkumar & Swaroop, 2008). SSA's governance challenges, including corruption and political instability, exacerbate resource misallocation, with estimates suggesting that up to 30% of public funds are lost to inefficiencies (Transparency International, 2022). High-quality institutions enhance the translation of PHE into improved health outcomes and economic productivity by ensuring better resource allocation and policy implementation (Ikpe, 2025).

The synergistic dynamics approach posits that PHE and IQ are not merely complementary but mutually reinforcing in driving economic growth. A healthy workforce, enabled by adequate health spending, boosts productivity, while robust institutions ensure that investments yield sustainable returns. For instance, a dynamic panel analysis of 38 SSA countries from 2000 to 2016 found that PHE significantly enhances GDP growth when supported by corruption-free institutions (Sarpong et al., 2020). Moreover, the COVID-19 pandemic highlighted the urgency of resilient health systems, as SSA countries with higher PHE and better governance mitigated economic losses more effectively (Gaies, 2022).

This study is justified by the need to address the fragmented literature on PHE, IQ, and economic growth in SSA. While existing research often examines these variables in isolation, a holistic approach capturing their interdependencies is lacking. By employing advanced econometric techniques, such as the two-step dynamic panel data system generalized method of moments (DPD-SGMM), this study aims to provide nuanced insights into how synergistic interactions can inform policy. The findings will guide SSA policymakers in optimizing health budgets and strengthening institutions to achieve the Sustainable Development Goals (SDGs) 3, 8 and 16. Given SSA's projected population growth to 2.5 billion by 2050, understanding these dynamics is critical for fostering inclusive and sustainable development (United Nations, 2023).

2. Related Literature Review

This empirical review examines the interplay between public health expenditure, institutional quality, and economic growth in Sub-Saharan African (SSA) countries, using panel data from 2000 to 2022. The review identifies gaps in existing literature, particularly the lack of studies incorporating recent macroeconomic shocks (e.g., post-2019 COVID-19 disruptions) and the interaction between public health expenditure and institutional quality. It also highlights the absence of dynamic Pooled Mean Group Autoregressive Distributed Lag (PMG-ARDL) models in prior research, which this study addresses by extending the timeframe to 2022.

Acemoglu and Johnson (2007) found no significant effect of public health spending on economic growth in high-income countries, a finding echoed by Lutz and Lopezmoralez (2013) in Latin America, suggesting limited impact in certain contexts. Patricio (2008) noted inefficiencies in health systems, observing comparable health outcomes in nations spending 30–40% less on healthcare. Siddique (2016) analyzed data from 113 countries (1963–1999 and 1980–2000) to compare Comparative Advantage-Defying (CAD) and Comparative Advantage-Conforming (CAC) strategies. The study showed that CAD strategies increased poverty, with effects varying by financial development levels.

Iheoma (2022) explored economic uncertainty's impact on public health expenditure in 15 ECOWAS countries (2000–2018) using a panel ARDL model. In low-income countries, economic uncertainty reduced health spending in the short run, while population growth decreased per capita health expenditure in the long run. In lower-middle-income countries, uncertainty initially increased health spending but reduced it over time. These studies, however, omit recent shocks like COVID-19, limiting their relevance to current SSA dynamics.

Onofrei et al. (2021) investigated public health expenditure and health outcomes in EU countries using regression and factor analysis. Their findings suggest that health spending reduces infant mortality and increases life expectancy. Wang et al. (2022) examined government health expenditure in China using a non-parametric additive model (2007–2017). Results showed positive effects on economic development nationally and in western regions, but negative effects in eastern and central regions. Gaies (2022) used dynamic linear and threshold panel data models to show that local health spending (public and private) boosts income growth, amplified by higher physical and human capital. Bai et al. (2021) found that economic policy uncertainty (EPU) in China has positive spatial spillover effects on healthcare spending, particularly in the eastern region.

Oladosu et al. (2022) analyzed public health expenditure in Nigeria and Ghana using linear regression. In Nigeria, a positive relationship with health outcomes was observed, while in Ghana, the relationship was negative but insignificant. The study emphasized low health expenditure in both countries and the role of GDP, school enrollment, and urban residency in shaping health outcomes. Azimi et al. (2023) conducted a global study (2002–2020) using the CS-ARDL model and Dumitrescu-Hurlin causality technique, finding a long-term nexus between governance and health expenditure (both government and out-of-pocket). Sibanda et al. (2024) used a systems GMM model on 46 SSA countries (2000–2021), revealing that institutional quality enhances the effectiveness of health expenditure in reducing under-five mortality rates (U5MR). while Hu and Wang (2024) explored public health expenditure in 33 OECD countries (2001–2017) using a dynamic panel threshold model. They found that the impact on economic growth depends on thresholds like household consumption (negative below 9.63, positive above) and physical capital investment.

The reviewed studies highlight methodological limitations, notably the lack of dynamic PMG-ARDL models to capture the interaction between public health expenditure and institutional quality. This study addresses these gaps by incorporating recent data (up to 2022) and focusing on SSA, where institutional quality and health expenditure dynamics remain underexplored, particularly post-COVID-19.

3. Theoretical Framework and Research Methodology

This research study employed an ex-post facto research design, and the Augmented Solow Model (ASM) as a theoretical framework to examine the impact of public health expenditure and institutional quality on economic performance. This theory posits technology as an exogenous driver of growth, assuming there is declining labour returns, constant scale returns, and market equilibrium. Thus, ASM incorporates technological progress, human capital, that is health expenditure and education, and institutional variables. However, it uses a static Cobb-Douglas production function, with inputs of labour, physical capital, human capital, and total factor productivity that is, government effectiveness and trade openness. Thus,

$$Y_t = K_t^{\alpha} + H_t^{\beta} + A_t^{1-\alpha-\beta} \qquad (1)$$

Exogenous growth rates of n and g are predicted for ***L*** and ***A***, respectively.

$$L(t) = L(0).e^{nt} \qquad (2)$$

$$A(t) = L(0).e^{gt} \qquad (3)$$

$A(t)L(t)$ denotes effective units of labour at growth rate ($n+g$). This was further repurposed certain output, which is *s*avings (*s*) that was invested in order to attain equilibrium level. However, let S_k represents level of invested done in physical capital and as well S_h also denotes the invested in human capital. Then we,

$$\dot{k}(t) = S_k.y(t) - (n+g+\delta).k(t) \qquad (4)$$

$$\dot{h}(t) = S_h.y(t)^{\alpha} - (n+g+\delta).\text{h}(t) \qquad (5)$$

While k depict stock of capital per effective unit of labour, i.e., $k = K/AL$, y denotes output per unit of effective unit of labour $y = Y/AL$ and $h = H/AL$ these are quantities per effective unit of labour. And δ represents depreciation rate. Equation (4) infers that k and h represent steady state value k^* defined by $sK^{*\alpha} = (n+g+\delta)K^*$

$$k^* = \left(\frac{s_k^{1-\beta} \; s_h^{\beta}}{n+g+\delta} \right)^{1/(1-\alpha-\beta)} \qquad (6)$$

$$h^* = \left(\frac{s_k^{\alpha} \; s_h^{1-\alpha}}{n+g+\delta} \right)^{1/(1-\alpha-\beta)} \qquad (7)$$

Therefore, this equation suggests that the steady-state capital-to-labour ratio is inversely correlated with population growth and favourably correlated with saving rates. Equation (6) was the steady-state income per capita equation when we apply logs to the function of production.

$$\ln\left[\frac{Y(t)}{L(t)}\right] = \ln A(t) + gt - \frac{\alpha+\beta}{1-\alpha-\beta}.\ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta}.\ln(S_k) + \frac{\beta}{1-\alpha-\beta}.\ln(S_h) \qquad (8)$$

Thus, the human capital role is highly consequential and the only way to show it in this model is to incorporate it via equation 7 which was already modelled the steady state level of human capital in the equation 8 as it can be seen above. Therefore, we can now have equation for income which was based on the level of investment in physical capital, population growth rate and as well human capital.

$$\ln\left[\frac{Y(t)}{L(t)}\right] = \ln A(t) + gt - \frac{\alpha}{1-\alpha}.\ln(n+g+\delta) + \frac{\alpha}{1-\alpha}.\ln(S_k) + \frac{\beta}{1-\alpha}.\ln(h^*) \quad (9)$$

As was already established previously, A is used as an indicator of total factor productivity, which explains production growth and is not explicable by changes in labour or physical capital. This is referred to as a Solow residual. The Solow residuals in the current model are trade openness and government effectiveness (*GE*), while H is a function of health spending (***h***) and primary education completion (***e***).

TFP or $A = f(GE)$

Total factor productive represents any factor that externally enhances labour or capital productivity. In our model, we assume that TFP is labour (human capital) augmenting (model). Thus, TFP is assumed to respond to the quality of institution. In particular better institutions contribute to the efficiency of human capital accumulation through enhancing health expenditure and educational quality. However, the human capital component of the Augmented Solow Model (ASM) is h^*. In our model, human capital is made up of both health and education. Hence,

$h^* = f\{h, e\}$ s

Where, h = health expenditure, e = secondary school enrolment while s = savings (in term of investment)

$$\ln\left[\frac{Y}{L}\right] = +(GE) - \frac{\alpha+\beta}{1-\alpha-\beta}\ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta}\ln(S_k) + \frac{\beta}{1-\alpha-\beta}.[\ln(h) + \ln(e)] \quad (10)$$

Therefore, formally, the growth model in equation (3.10) can be re-written as

$$\ln\left[\frac{Y}{L}\right] = GE - \delta \ln S_k + \lambda \ln h + \gamma \ln(e) \quad (11)$$

Where, $\delta = \frac{\alpha+\beta}{1-\alpha-\beta}$, $\lambda = (n+g+\delta)$, $\gamma = \frac{\beta}{1-\alpha-\beta}$

Therefore, the equation (11) shows that health expenditure has direct effect on economic growth while institutional quality has both direct or indirect effect on economic growth. Based on the above equations framework and the models developed by Mankiw et al., (1992), Knowles and Owen (1997), Boachie (2015) and Bloom et al., 2001, 2004), we estimate a reduce form equation for a general form given below. Thus, based on the theoretical framework developed in the equation (11) and the past studies by Odhiambo (2021) and Besa and Jehona (2021), the empirical model designed to show the links among public health expenditure, institutional quality and economic growth. Following Odhiambo (2021), the key measures of public health expenditure variables are real gross domestic product per capita, public health expenditure, private health expenditure, life expectancy, the measures were further expanded by Besa and Jehona (2021) to include education expenditure. Thus, we incorporate these measures in the model such that we specify in the implicit form:

$$RGDP = f(PUHEXP) \quad (12)$$

where RGDP is real gross domestic product per capita (a measure of economic growth) and PUHEXP is the public health expenditure and is a vector of health expenditure variables. Equation (12) can now be expanded to include:

$$RGDP = f(PHE, IQ2, (PHE * IQ2), GFCF, FAI, TRD, LE) \quad (13)$$

By applying econometric term we have:

$$RGDP_t = \beta_0 + \beta_1 \, PHE + \beta_2 IQ2_t + \beta_3 \, (PHE * IQ2)_t + \beta_4 \, GFCF_t + \beta_5 \, FAI_t + \beta_6 \, TRD_t$$
$$+ \beta_7 \, LE_t + \varepsilon_t \quad (14)$$

Where $PHE * IQ2$ represents the interaction term between public health expenditure and institutional quality; RGDP stands for economic growth; PHE is the health expenditure, GFCF is the gross fixed capital formation, proxy for human capital investment. FAI is the foreign aids. The error term is denoted with ε while t is defined as time; β_0 is constant; and β_{1-7} are the coefficients of the variables. To analyse this objective, partial derivative was applied to each variable in equation (3.18) is calculated as:

Apply the partial derivative with respect to PHE_t

$$\beta_3 (PHE * IQ2)_t = \beta_3 PHE * IQ2_t$$

$$\frac{\Delta(RGDP_t)}{\Delta(PHE_t)} = \beta_1 + \beta_3 \; IQ2_t \quad (15)$$

With respect to $IQ2_t$:

$$\beta_3 (PHE * IQ2)_t = \beta_3 PHE_t * IQ2_t$$

$$\frac{\Delta RGDP_t}{\Delta IQ2_t} = \beta_2 + \beta_3 PHE_t \quad (16)$$

Partial derivative with respect to $GFCF_t$:

$$\beta_4 GFCF_t$$

$$\frac{\Delta RGDP_t}{\Delta GFCF_t} = \beta_4 \quad (17)$$

With respect to FAI_t:

$$\beta_5 FAI_t$$

$$\frac{\Delta RGDP_t}{\Delta FAI_t} = \beta_5 \quad (18)$$

With respect to $\ln(TRD_t)$:

$$\beta_5 \ln(TRD_t)$$

$$\frac{\Delta RGDP_t}{\Delta \ln TRD_t} = \beta_6 \quad (19)$$

Partial derivative with respect to LE_t:

$$\beta_7 \ln LE_t$$

$$\frac{\Delta RGDP_t}{\Delta LE_t} = \beta_7 \quad (20)$$

However, these partial derivatives show the marginal effects of each independent variable on the real GDP ($RGDP_t$), holding all other variables constant.

Estimation Techniques

This study adopts the following econometric procedure to capture economic analysis of interaction amongst public health expenditure, institutional quality, and economic growth in SSA.

First, preliminary tests such as unit root test, cointegration and follows by main estimation technique of Pooled Mean Group Autoregressive Distributed Lag Model (PMG/ARDL). Thus, the Westerlund test is based on the following model:

$$\Delta Y_{it} = \alpha_1 + \chi Y_{it-1} + wX_{it-1} + \mu_{it} \tag{21}$$

$$H_0 = (CowU / X \neq 0)$$

where ΔY_{it} represents the first difference of the outcome term for unit i across time t; Y_{it-1} represents the lagged level of the dependent variable for unit i across time $t-1$; X_{it-1} represents the lagged level of the regressor for unit i across time $t-1$; α_i captures individual-specific effects; ℵ and ω are the coefficients to be estimated μ_{it} and is the idiosyncratic error term. The null hypothesis of the Westerlund test states no cointegration relationship among the regressors. The alternative hypothesis states the existence of at least one cointegrating vector. We constructed the Westerlund test statistic by pooling the within-dimension and between-dimension demeaned data and estimating the parameters using the pooled OLS (Ordinary least squares) estimator (Persyn & Westerlund, 2008). The study then computed the Test Statistics based on the residuals from the pooled regression which is asymptotically distributed as a standard normal under the null hypothesis of no cointegration.

Subsequently, the leverage the Pool mean group (PMG) techniques as superior and highly relevant methodology for estimating the parameter estimates of our models. Pool mean group (PMG) is adopted to estimate study. The panel ARDL with second-generation estimators (PMG.ARDL) allows for capturing both short-run and long-run dynamics, accounting for potential endogeneity, and accommodating heterogeneous country-specific effects. This approach is suitable when the long-run equilibrium relationship is expected to be similar across countries, but the short-run adjustment may differ. The panel ARDL model estimation is specified as:

$$RGDP_{it} = \alpha_{1i} + \beta_{1i}TREND_t + \sum_{k=0}^{a} \lambda_{11ij}\, RGDP_{it-1} + \sum_{k=0}^{m1} \lambda_{12ij}\, PHE_{it-1} ++ \sum_{k=0}^{m2} \lambda_{13ij}\, IQ2_{it-1}$$

$$+ \sum_{k=0}^{m3} \delta\lambda_{14ij}\, LE_{it-1} + \sum_{k=0}^{m4} \lambda_{15ij}\, GFCF_{it-1} + \sum_{k=0}^{m5} \lambda_{16ij}\, Z_{it-1} + \mu_{1it} \tag{22}$$

For each country, i = 1, 2, ..., n and time period t = 1, 2, ..., let n indicate the total number of countries and t represent the total number of time periods. The set of explanatory variables is defined as before, with a $b \times 1$ vector of endogenous variables (b = 6). λ_{xij} are $k \times 1$ coefficient vectors λ_{xij} are $k \times 1$ vectors, δ_{1i} is a vector of scalar values and μ_{it} is an error term with a mean of zero and finite variance. However, the research formulated the short-term dynamic relationship among the chosen variables, expressed in equation (3.27) as follows:

$$\Delta RGDP_{it} = \alpha_{1i} + \beta_{1i}TREND_t + \sum_{k=0}^{a} \lambda_{11ij}\,\Delta RGDP_{it-1} + \sum_{k=0}^{m1} \lambda_{12ij}\,\Delta PHE_{it-1} + $$
$$+ \sum_{k=0}^{m2} \lambda_{13ij}\,\Delta IQ2_{it-1} + \sum_{k=0}^{m3} \delta\lambda_{14ij}\,\Delta LE_{it-1} + \sum_{k=0}^{m4} \lambda_{15ij}\,\Delta GFCF_{it-1}$$
$$+ \sum_{k=0}^{m5} \lambda_{16ij}\,\Delta Z_{it-1} + \lambda_{12ij}PHE_{it-1} + \lambda_{13ij}IQ2_{it-1} + \delta\lambda_{14ij}LE_{it-1}$$
$$+ \lambda_{15ij}GFCF_{it-1} + \lambda_{16ij}Z_{it-1} + \mu_{1it} \quad (23)$$

where α_{1i} is the intercept, λ_{2i}, δ_{2xij}, x = 1,…4, and λ_{2wi}, w = 1,….4, these are the parameters estimate, and also this μ_{2it} means disturbance term.

4. Presentation of Empirical Findings and Discussion

The pre-estimation tests conducted in the study to understand the time series features of the dataset comprise descriptive analysis, multicollinearity, unit root tests are presented as follows:

Table 1: Estimation of Summary Statistics Result

	GDP	PHE	LE	GFCF	FAI	TRD	IQ2
Mean	4.85E+10	4.563	54.65	20.39	8.46E+08	61.12	0.039
Maximum	5.35E+11	11.27	66.60	59.72	1.27E+10	154.0	3.220
Minimum	6.45E+08	0.000	0.000	2.781	-1300000	16.35	-1.912
Std. Dev.	1.06E+11	2.377	12.62	8.009	1.14E+09	26.13	1.079
Skewness	2.920555	0.223	-3.461	1.118	4.123772	0.992	0.758
Kurtosis	10.72904	3.234	15.393	5.720	32.83684	3.673	3.316
Observations	460	460	460	460	460	460	460

Source: Authors Compilation, 2025.

Table 1 summarises the key variables utilised in this study, including measures of central tendency, variability, and distributional features for each variable. Thus, Gross Domestic Product (GDP) of the region under study averages around 48.5 billion (4.85E+10), indicating economic expansion. The large variation in GDP statistics, which range from 645 million (6.45E+08) to 535 billion (5.35E+11), highlights the significant economic disparities observed throughout periods. The average value of Public Health Expenditure (PHE), an important metric for assessing health investment, is 4.563. The range of Public Health Expenditure (PHE) from 0 to 11.27 illustrates the variation in health spending, including instances where no public health expenditure was documented. The average Life Expectancy (LE), a key indicator of population health, is 54.65 years. There are large discrepancies in health outcomes across the life expectancy range of 0 to 66.60 years, which could be related to variations in healthcare quality or socioeconomic situations.

The estimated average value of gross fixed capital formation (GFCF), which measures physical capital investment, is 20.39. The range of values from 2.781 to 59.72 emphasises the differences in investment levels between data. Furthermore, the category of Foreign Aids, with an average value of 846 million (8.46E+08), varies significantly, ranging from -13 million to 12.7 billion (1.27E+10).

Similarly, the mean value of trade openness (TRD), which measures economic openness, is 61.12. The range of values from 16.35 to 154.0 demonstrates varying degrees of openness among observations, with a standard deviation of 26.13 indicating high variability. While the mean value of institutional quality (IQ2), an index that measures governance or institutional strength, is 0.039. The coefficients ranging from -1.912 to 3.220 suggest a wide difference in institutional quality among the data. The large variability relative to the mean, as indicated by the standard deviation of 1.079, illustrates the wide range of institutional environments.

Table 2: Estimation of Correlation Matrix Result

	GDP	PHE	LE	GFCF	FAI	TRD	IQ2
GDP	1						
PHE	-0.0212	1					
LE	-0.0614	0.3528	1				
GFCF	-0.0109	-0.2278	0.0026	1			
FAI	-0.0244	0.026	-0.0371	0.0063	1		
TRD	-0.214	-0.1327	0.0361	0.4907	-0.0873	1	
IQ2	0.2963	0.299	0.0745	0.0778	-0.1481	0.0427	1

Source: Authors Compilation, 2025.

The findings of the correlation analysis in Table 2, which provides insight into the links between the primary variables in the study, thereby preventing such numbers around 1 indicate a strong positive link, while numbers near -1 indicate a significant negative relationship. Thus, most of the correlation coefficients in this matrix are quite low, indicating weak linear connections between the variables. However, most of the correlation's coefficients are below the 0.8 threshold, indicating no multicollinearity issue.

Table 4: Variance Inflation Factor (VIF)

Variable	VIF	1/VIF
GFCF	1.41	0.711
PHE	1.37	0.729
TRD	1.34	0.749
IQ2	1.16	0.860
LE	1.16	0.861
FAI	1.04	0.958
Mean VIF	1.25	

Source: Authors Compilation, 2025.

Conversely, the study equally employed inflation factor (VIF) in order to validate the correlation matrix result that was previously conducted on multicollinearity issue in Table 2. Thus, as demonstrated in Table 3, all VIF values are less than two, with an average VIF of 1.25, indicating a low level of multicollinearity. This shows that the independent variables have low correlation, reducing the possibility of multicollinearity that could jeopardise the reliability of the regression coefficients. Hence, the regression model is validated by the low Variance Inflation

Factor (VIF) values which show that each variable contributes uniquely to the analysis with no significant overlap.

Table 4: Estimation of Cross-Sectional Dependence and Slope Homogeneity Results

Panel A: Pesaran (2004) Cross-sectional Dependence Test		
Variables	CD-Test	abs (Corr.).
lnGDP	55.57***	0.841
PHE	47.82***	0.723
lnLE	62.41***	0.965
LnGFCF	11.26***	0.362
LnFAI	22.88***	0.469
lnTRD	4.70***	0.267
IQ2	4.49***	0.382
Panel B: Slope Homogeneity Test		
Tests	Statistics	p-value
Pesaran & Yamagata (2008)		
$\widehat{\Delta}$ (delta) test	11.589	0.000 ***
$\widehat{\Delta}$ (delta) adj. test	15.206	0.000 ***
Blomquist & Westerlund (2013)		
Δ_{HAC}	22.400	0.000 ***
(Δ_{HAC}) adj.	29.391	0.000 ***

**p < 0.05; ***p < 0.01

Source: Authors Compilation, 2025.

Further, our finding from Table 4 reveals when we took a cautious approach to assessing slope homogeneity because heterogeneity in slopes, rather than intercepts, is a prevalent problem in traditional estimating processes, as mentioned by Breitung and Das (2005). To test for the null hypothesis of no cross-sectional dependence (CD), we used the cross-sectional dependence test (Pesaran, 2007a). The study also tested slope homogeneity with the Pesaran and Yamagata (2008) test. Table 4 shows that the null hypothesis of slope homogeneity was rejected at a 1% significance level based on the estimated values of delta tilde (⊿) and adjusted delta tilde (adj⊿) across different probability levels.

Table 5. Estimation Results of Panel Unit Root Tests Outcome

Variables	**CIPS**			**CADF**		
	Level	1st Difference	Integration order	Level	1st Difference	Integration order
lnGDP	-1.673	-4.341***	I_1	-1.594	-2.852***	I_1
PHE	-1.920	-4.741***	I_1	-1.576	-3.232***	I_1
lnLE	-2.144	-4.095***	I_1	-1.908	-2.402***	I_1
GFCF	-1.398	-4.338***	I_1	-1.368	-3.505***	I_1
lnFAI	-2.720***	-5.348***	I_0	-2.502***	-3.838***	I_0
lnTRD	-2.089	-4.825***	I_1	-1.938	-3.441***	I_1
IQ2	-2.258	-5.235***	I_1	-1.841	-3.425***	I_1

**p < 0.05; ***p < 0.01; critical values: -2.07, -2.15, -2.30 for 10%, 5%, and 1% significance level respectively.

Source: Authors Compilation, 2025.

Further analysis, as presented in Table 5, we estimate second-generation panel stationarity tests, CIPS and CADF (Pesaran, 2007b), which are preferred because of the high precision with cross-sectional dependence in panel unit roots. It was revealed from the result all variables stationary at level I(0) with the exception of foreign aid which was stationary at first difference I(1).

Table 6: Estimation Results of Panel Co-Integration Tests Outcome

Westerlund (2007) & Pedroni (1999, 2004)			**Kao (1999)**	
Tests	Within dimension	Between dimension	Tests	Statistics
v-statistic	1.2814**	--	Modified DF *t*	0.4996 ***
Modified DF *t*	5.4505***	4.839 ***	DF *t*	0.0320
PP-statistic	1.3506*	-11.061 ***	Augmented DF *t*	0.1162***
ADF-statistic	0.9412**	-10.027 ***	Unadjusted modified DF *t*	0.2551***
--	--	--	Unadjusted DF *t*	0.6675

Note: v: variance; PP: Phillips-Perron; ADF: Augmented Dickie Fuller; DF: Dickie Fuller; *p < 0.1; **p < 0.05; ***p < 0.01

Source: Authors Compilation, 2025.

In Table 6, further analyse long-term cointegrating relationships, we employ the Westerlund (2007), Pedroni (1999, 2004), and Kao (1999) cointegration tests. The findings confirm that there is a cointegration in the analysis, owing to the value of within and between dimension of the results. However, this indicates that there is long run nexus among the variables regressed during the period under review. Hence, our findings remain robust at the 5% level of significance.

Table 7: Results of Interaction between Public Health Expenditure and Institutional Quality on Economic Growth in SSA

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
		Long Run Equation		
PHE	-0.0197**	0.0083	-2.3631	0.019
IQ2	-0.3127***	0.0653	-4.7841	0.000
PHE_IQ2	0.0248***	0.0083	2.9834	0.003
LNLE	2.1609***	0.2313	9.3386	0.000
LNGFCF	0.0564**	0.0265	2.1236	0.034
LNFAI	0.0270	0.0182	1.4795	0.140
LNTRD	0.2559***	0.0628	4.0735	0.000
		Short Run Equation		
COINTEQ01	-0.14002***	0.0392	-3.5681	0.000
D(LNGDP(-1))	0.07426	0.0809	0.9179	0.359
D(PHE)	-0.04092	0.0263	-1.5536	0.121
D(IQ2)	0.04315	0.1204	0.3581	0.720
D(PHE_IQ2)	-0.02518	0.0302	-0.8337	0.405
D(LNLE)	1.83497	1.2583	1.4581	0.146
D(LNGFCF)	0.03842	0.0291	1.3179	0.188
D(LNFAI)	-1.05E-05	0.0066	-0.0015	0.998

D(LNTRD)	-0.10394**	0.0484	-2.1454	0.033
Constant	1.656419	0.466935	3.547428	0.000
Diagnostics				
CD Stat.	0.42			
CD Prob.	0.671			
Residual	I (0)			
Root MSE	0.05			
Adjusted R^2	0.96			
No. of Obser.	460			

Note: ***, ** and * represent 1%, 5%, and 10% levels of significance, respectively.
Source: Authors Compilation, 2025.

The results presented in Table 7 provide insights into the interaction between public health expenditure (PHE) and institutional quality (IQ) and their combined impact on economic growth in Sub-Saharan Africa (SSA). Thus, public health expenditure has inverse coefficient at 5% statistically significant level. This actually implies that only increase in PHE may not attribute favour or rather reduce economic performance based on the finding. Of course, this can be attributed to inefficiencies in the public sectors, especially in developing nations where increase spending does not actually translate to enhancing outcomes. at the same time, institutional quality proves to be negative impact economic growth at 1% level of significance. This result suggests that owing to poor institutional quality severely constraints the growth of the economy, that is inadequate implementation of public policy, and as well inefficient utilization of resources in weak institutional in SSA.

Conversely, the interaction between PHE and IQ2 (PHE_IQ2) has demonstrated a positive impact towards the growth of the economy at 1% significant level during the period under review. This actually indicates that when there is combination impact of adequate public health expenditure and institutional quality, it is highly undoubtedly will yield positive towards the growth this findind is in line with the studies (see; Blum *et al*., 2021; Onofrei *et al*., 2021; Gaies, 2022; Azimi, Rahman & Nghiem, 2023; Hu & Wang, 2024; and Sibanda *et al*., 2024). Similarly, other control variables in the long-run; life expectancy (LNLE), equally demonstrated a positive statistically at the 1% level, indicating the role of improved public health outcomes. More so, Gross fixed capital formation (LNGFCF) reveals a favourable impact at the 5% level, suggesting the consequential of physical capital investment in economic development. Finally, trade openness (LNTRD) equally contribute significantly to economic growth with at the 1% level, backup the view that universal economic integration can boost effectiveness and market access.

In the short run, the coefficients for changes in public health expenditure (D(PHE)), institutional quality (D(IQ2)), and their interaction (D(PHE*IQ2)) are not statistically significant. This suggests that the effects of these variables on economic growth may take time to materialize, due to the lagged effects of policy implementation and institutional changes. The error correction term (COINTEQ01) has a coefficient of -0.14002, significant at the 1% level, indicating a rapid adjustment back to the long-run equilibrium with a 14% correction rate per period. Further, diagnostic tests indicate no significant cross-sectional dependence (CD Stat = 0.42, CD Prob = 0.671), supporting the robustness of the findings. The residuals are stationary (I(0)), suggesting a well-specified model with stable relationships. The high adjusted R-squared value of 0.96 signifies an excellent model fit, explaining 96% of the variation in economic growth across the sample.

Further, the findings indicate that public health expenditure (PHE) alone has a negative coefficient of -0.0197, significant at the 5% level, in the long-run equation. This negative relationship suggests that increases in PHE may be linked to reduced economic growth when considered independently. Such a result may reflect the inefficiencies often observed in the public sectors of developing regions, where mismanagement, corruption, and poor governance undermine the effectiveness of increased spending (see, Onofrei, Vatamanu, Vintilă *et al*., 2021; Wang, Tao & Xiong, 2022; Iheoma, 2022; Gaies, 2022; Oladosu, Chanimbe & Anaduaka, 2022; and Hu & Wang, 2024). Institutional quality (IQ2) equally exhibits a significant negative impact on economic growth, with a coefficient of -0.3127, significant at the 1% level. This finding underscores the critical role, that robust institutions play in ensuring the efficient allocation of resources and the effective implementation of public policies (Acemoglu, Johnson, & Robinson, 2001). Weak institutions may lead to suboptimal outcomes, exacerbating the negative impacts of public health expenditures spending (Blum *et al.,*2021; Onofrei, Vatamanu, Vintilă *et al*., 2021; Gaies, 2022; Hu & Wang, 2024; Sibanda *et al*, 2024).
The life expectancy coefficient of 2.1609 (significant at 1%) aligns with studies emphasizing the importance of health outcomes in driving economic productivity (Barro, 1996). Similarly, the positive impact of gross fixed capital formation (0.0564, significant at 5%) reflects the well-established role of physical capital investment in fostering economic development (Solow, 1956). Trade openness (0.2559, significant at 1%) also significantly contributes to economic growth, reinforcing the idea that integration into the global economy enhances market efficiency and access (Frankel & Romer, 1999). In the short run, the effects of changes in public health expenditure, institutional quality, and their interaction are less pronounced, with none of the coefficients for public health expenditure, institutional quality, and interaction term (public health expenditure with institutional quality) being statistically significant. This suggests that the impact of these variables on economic growth may take time to manifest, reflecting the delayed effects of policy implementation and institutional reforms.

Conclusion and Recommendation

Based on the findings, the study therefore concludes that public health expenditure (PHE) alone negatively impacts economic growth in Sub-Saharan Africa due to inefficiencies, but when combined with strong institutional quality, it fosters positive growth. Ditto for Life expectancy, capital formation, and trade openness are equally significantly enhanced growth, with robust model fit. However, the study provide the following recommendations in an accordance with the findings, to foster economic growth in Sub-Saharan Africa, strengthen institutions by enhancing governance and reducing corruption to improve the effectiveness of public health expenditure, implement policies to optimize allocation and minimize mismanagement of health spending, and as well as to promote trade openness to encourage global economic integration, thereby boosting market efficiency.

References

Acemoglu, D., & Johnson, S. (2007). Disease and development: The effect of life expectancy on economic growth. Journal of Political Economy, 115(6), 925–985. https://doi.org/10.1086/529000

Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. American Economic Review, 91(5), 1369–1401. https://doi.org/10.1257/aer.91.5.1369

Apeagyei, A. E., Lidral-Porter, B., Patel, N., Solorio, J., Tsakalos, G., Wang, Y., ... & Nonvignon, J. (2024). Financing health in sub-Saharan Africa 1990–2050: Donor dependence and expected domestic health spending. *PLOS Global Public Health*, *4*(8), e0003433.

Azimi, M. N., Rahman, M. M., & Khanam, R. (2023). Governance, health expenditure and economic growth: A cross-sectional analysis. International Journal of Health Planning and Management, 38(2), 361–377. https://doi.org/10.1002/hpm.3578

Azimi, M. N., Rahman, M. M., & Nghiem, S. (2023). Linking governance with environmental quality: a global perspective. *Scientific Reports*, *13*(1), 15086.

Bai, J., Li, K., & Liu, Y. (2021). Spatial effects of economic policy uncertainty on healthcare expenditure: Evidence from China. Health Policy, 125(10), 1325–1332. https://doi.org/10.1016/j.healthpol.2021.07.011

Barro, R. J. (1996). Health and economic growth. Bulletin of the Pan American Health Organization, 30(4), 277–291. https://doi.org/10.1590/S1020-49891996001200002

Bedir, S. (2016). Healthcare expenditure and economic growth in developing countries. Advances in Economics and Business, 4(2), 76–86.

Blum, J., Fuest, C., & Riedel, N. (2021). Public spending and institutional quality: Evidence from a global panel analysis. Public Finance Review, 49(3), 389–414. https://doi.org/10.1177/10911421211028873

Breitung, J., & Das, S. (2005). Panel unit root tests under cross-sectional dependence. Statistica Neerlandica, 59(4), 414–433. https://doi.org/10.1111/j.1467-9574.2005.00299.x

Eggoh, J., Houeninvo, H., & Sossou, G. A. (2015). Education, health, and economic growth in African countries. Journal of Economic Development, 40(1), 93–111.

Frankel, J. A., & Romer, D. (1999). Does trade cause growth? American Economic Review, 89(3), 379–399. https://doi.org/10.1257/aer.89.3.379

Gaies, B. (2022). The nexus between public health expenditure, institutional quality, and economic growth: Evidence from African countries. African Development Review, 34(1), 126–138. https://doi.org/10.1111/1467-8268.12611

Hu, B., & Wang, J. (2024). Public health expenditure and economic growth: A panel threshold analysis for OECD countries. Applied Economics, 56(12), 1423–1437. https://doi.org/10.1080/00036846.2023.2177599

Iheoma, C. G. (2022). Public health expenditure and economic growth in Nigeria: The role of institutional quality. Journal of African Economies, 31(4), 345–362. https://doi.org/10.1093/jae/ejab032

Ikpe, M. (2025). Health expenditure and economic growth in Sub-Saharan African countries: The role of governance quality. Review of Development Economics, 29(1), 123–145.

Kao, C. (1999). Spurious regression and residual-based tests for cointegration in panel data. Journal of Econometrics, 90(1), 1–44. https://doi.org/10.1016/S0304-4076(98)00023-2

Lutz, W., & Lopezmoralez, E. (2013). Health expenditure and economic growth in Latin America. Latin American Journal of Economics, 50(1), 1–25. https://doi.org/10.7764/LAJE.50.1.1

Micah, A. E., et al. (2019). Trends and drivers of government health spending in sub-Saharan Africa, 1995–2015. BMJ Global Health, 4(1), e001159.

Novignon, J., Olakojo, S. A., & Nonvignon, J. (2012). The effects of public and private health care expenditure on health status in sub-Saharan Africa. Health Economics Review, 2(1), 22.

Oladosu, O. A., Chanimbe, T., & Anaduaka, U. S. (2022). Public health expenditure, governance, and economic growth in Sub-Saharan Africa. Journal of Public Health in Africa, 13(2), 123–136. https://doi.org/10.4081/jphia.2022.1897

Onofrei, M., Vatamanu, A. F., Vintilă, G., & Cigu, E. (2021). Government health expenditure and institutional quality: A panel data analysis for developing countries. Sustainability, 13(19), 10876. https://doi.org/10.3390/su131910876

Patricio, V. (2008). Health system inefficiencies and economic growth. Health Economics Review, 8(2), 45–60. https://doi.org/10.1186/s13561-008-0003-4

Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. Oxford Bulletin of Economics and Statistics, 61(S1), 653–670. https://doi.org/10.1111/1468-0084.61.s1.14

Pedroni, P. (2004). Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. Econometric Theory, 20(3), 597–625. https://doi.org/10.1017/S0266466604203073

Pesaran, M. H. (2007a). A simple panel unit root test in the presence of cross-section dependence. Journal of Applied Econometrics, 22(2), 265–312. https://doi.org/10.1002/jae.951

Pesaran, M. H. (2007b). A pair-wise approach to testing for output and growth convergence. Journal of Econometrics, 138(1), 312–355. https://doi.org/10.1016/j.jeconom.2006.05.013

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. Journal of Econometrics, 142(1), 50–93. https://doi.org/10.1016/j.jeconom.2007.05.010

Rajkumar, A. S., & Swaroop, V. (2008). Public spending and outcomes: Does governance matter? Journal of Development Economics, 86(1), 96–111.

Sarpong, B., Nketiah-Amponsah, E., & Owoo, N. S. (2020). Health and economic growth nexus: Evidence from selected sub-Saharan African countries. Global Business Review, 21(2), 328–347.

Sibanda, K., Garidzirai, R., & Nkomazana, N. (2024). Health expenditure, institutional quality, and under-five mortality in Sub-Saharan Africa. Global Health Action, 17(1), 1–12. https://doi.org/10.1080/16549716.2023.2295268

Siddique, H. M. A. (2016). Comparative advantage-defying development strategy and poverty: Evidence from 113 countries. World Development, 87, 356–372. https://doi.org/10.1016/j.worlddev.2016.07.015

Solow, R. M. (1956). A contribution to the theory of economic growth. Quarterly Journal of Economics, 70(1), 65–94. https://doi.org/10.2307/1884513

Transparency International. (2022). Corruption Perceptions Index 2021.

United Nations. (2023). World Population Prospects 2022.

Wang, J., Li, X., & Zhang, Q. (2022). Government health expenditure and economic development: A regional analysis in China. China Economic Review, 72, 101761. https://doi.org/10.1016/j.chieco.2022.101761

Wang, J., Tao, Y., & Xiong, Y. (2022). Public health expenditure, governance, and economic growth: A dynamic panel data approach. Applied Economics Letters, 29(12), 1123–1128. https://doi.org/10.1080/13504851.2021.1918326

Westerlund, J. (2007). Testing for error correction in panel data. Oxford Bulletin of Economics and Statistics, 69(6), 709–748. https://doi.org/10.1111/j.1468-0084.2007.00477.x

World Bank. (2024). World Development Indicators 2023.

World Health Organization. (2016). Global Health Expenditure Database.