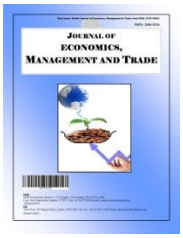

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The Effect of Private and Public Health Expenditure on Economic Growth in Sub-Saharan Africa

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study examined the relationship between health expenditure and economic growth in sub-Saharan Africa. The General Method of Moments (GMM) estimation technique was used and the data covered the period 2000-2019 for forty-six countries. The results of the difference GMM-1 and GMM-2 steps indicate that a 1% change in public health expenditure per capita (LPUHE_PC) is associated with a 0.1362% and 0.1521% rise in GDP per capita (GDP_PC) in the short run. The system GMM-1 and GMM-2 steps indicate that a percentage change in LPUHE_PC is associated with a respective 0.0148% and 0.0109% rise in GDP_PC in the short run at a 1% level of significance, on average ceteris paribus. In the long run, the difference GMM-2 step indicates that a 1% change in the LPUHE_PC has a larger positive effect on the GDP_PC (1.34899%) than in the short-run (0.1521%). The result of the system GMM-1 and GMM-2 step indicates that a 1% change in LPUHE_PC has a larger positive effect on the GDP_PC in the long run (0.39967% and 0.24135%) than in the short-run (0.0148% and 0.0109%) respectively. This analysis indicates that a rise in government health spending will stimulate economic growth with a larger effect in the long run than in the short run in Sub-Saharan Africa. Thus, the government should increase health budgetary allocations.

Keywords: Public spending; General Method of Moments (GMM); economic growth; GDP per capita; long run.

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1. INTRODUCTION

The two main functions of the government in any given society are fortification (security) and the supply of certain public goods. Public expenditures include defense, roads, education, health, and power under the terms of public goods. Increased government spending on socioeconomic and physical infrastructures, according to some researchers, promotes economic growth. Labor productivity and national production growth are highly improved when Government expenditure on education and health, is on the increase. Similarly, lower production costs, infrastructure expenditure, such as power, roads, and communications could enhance firm profitability, and private sector investment, which promote economic growth [1,2] investigated the association between national health outcomes and public health spending in developed countries, discovering that government expenditure was negatively correlated with infant mortality rate and positively associated with expected living-period.

Private health expenditure components include payments directly for health by corporations, households (out-of-pocket expenditure), and charitable health cover, and is defined as a proportion of total health expenses. The household's expenditure accounts for 32 percent to 38 percent of overall healthcare spending in Sub-Saharan Africa. In Sub-Saharan Africa, health spending increases life expectancy and reduces newborn mortality, under-five mortality, and crude death. Private health spending has also been proven to have a significant positive link on expected living-period and a negative impact on below five years mortality [3].

Inadequate investment from corporate and public sectors makes improving health outcomes in Africa difficult. Most African governments find it difficult to devote at least 15% of their yearly financial plan to the health division, as recommended by the World Bank. This can be attributed to rising healthcare expenses and the economic crisis, both of which have increased the burden on healthcare spending. Infrastructure, equipment, and qualified health care practitioners are all lacking in these African countries' healthcare systems. In 2010, African countries spent an average of US$ 135 per capita on health, compared to US$ 3150 in high-income countries. Furthermore, in 2016, health spending per capita in the Latin American and Caribbean regions, European Countries, Sub-Saharan Africa and North America, and was approximately $ 63, $3,183, $84, and, $9,031correspondingly [4]. This demonstrates how distant African countries are from meeting the bare minimum of health-care requirements, let alone catering to the health needs of Africans in particular [3]. This has resulted in higher rates of mother and newborn mortality, HIV/AIDS, and other deadly diseases in Africa. These figures show that Sub-Saharan African countries need to invest more in health to catch up with other parts of the world.

Even before the advent of the covid-19 pandemic, global health spending has continued to rise, albeit at a slower rate in recent years. In 2016, the global health budget was US$7.6 trillion, which grew to US$7.8 trillion in 2017. 2018 was the first time in five years that global health spending increased slower than GDP World Health Organization, [5]. An Increase in investment is required to keep up with the needs of preserving the population's excellent health, the health department, faster than the economy keeps developing. In real terms, GDP and global health spending, raised by 3.0 percent and by 3.9 percent per year respectively between 2000 and 2017.

This study looked at the impact of private and public health spending on Sub-Saharan Africa's economic growth, as well as the validity of Wagner's theory of government spending, The expansion of an economy and the increase of government operations are functionally related, according to this theory, the latter is growing at a faster rate than the former.

2. LITERATURE REVIEW

2.1 The Trend of Private and Public Health Expenditure

2.1.1 Private health expenditure

This has to do with spending from collective assets that are not within government power, like payments directly for health by corporations, the out-of-pocket expenditure from the households, and charitable health cover and is defined as a proportion of total health expenses on health. Some countries like Nigeria and Ghana expenditure out-of-pocket for health is more than 60% and 55% respectively and on a relative increase in Nigeria but a decrease in Ghana from the year 2000 to 2018 as shown in Fig. 1 below. This shows that in Ghana out-of-pocket

expenditure is on a decline and this signifies that other means of health care expenditure, for instance, public health expenditure is steadily kicking out the health care payment from out-of-pocket while in Nigeria healthcare is dominated by the out-of -pocket expenditure which is annually on the rise. Countries like South Africa have low figures of l7.7% as of 2018 and Angola has unsteady figures ranging from 15% to 49%. Sub-Saharan Africa as a whole, has a range of 32%-38% of total health care payments which is using out-of-pocket spending.

2.1.2 Public health expenditure

This denotes the amount of money spent on health care by the government and this amount of money is obtained from the social security schemes, local government bodies, state and regional. State capital formation in health includes both public investment in health facilities and capital transfers to the private sector for hospital building and equipment. Capital spending from municipal and central government financial plans, and foreign borrowings, social health cover, and grants funds are included in public health spending. The impact of major changes in government spending on the gross domestic product was investigated, and it was discovered that, contrary to popular belief, more government spending may not be the best way to grow the Zambian economy [6]. Public health coverage in Egypt offered free health service via the ministry of health. The country currently is working on improving its public health care system [7].

The dynamic interaction or association between macroeconomic factors and public health expenditure of India's 15 major states from 1990-2014 was a study carried by Behera and Dash [8]. The result of empirical studies has shown that the financing of the health care of Indian states is mainly by the public providers (the central transfer- tax devolution and state's revenue -tax revenue and indirect tax). There is no impact exhibited by other sources (non-tax revenue and direct tax) of government revenue in the short run on the spending of public –health but in the long run, the impact was positive. As a result, it was found that a favorable impact on public health expenditure, in the long run, is traceable to fiscal balance and the growth of the economy. The adequate utilization of grants from the central and a rise in the tax base due to enhanced way of a collection of revenue would bring about in the economy fiscal space as a result channeling enough funds toward public health care by the government become practical.

Fig. 2 below shows that the public expenditure per capita on health excluding funds from external sources for sub-Saharan Africa increased from approximately $10 in the year 2000 to $30 US dollars in 2018. Nigeria, Mali, and Togo also experienced increases as shown also in the graph below with Kenya having an impressive increase from $5.8 to $37 in 2018. Despite the notable increases, the recommended $44 recommendation hasn't been reached as of 2018.

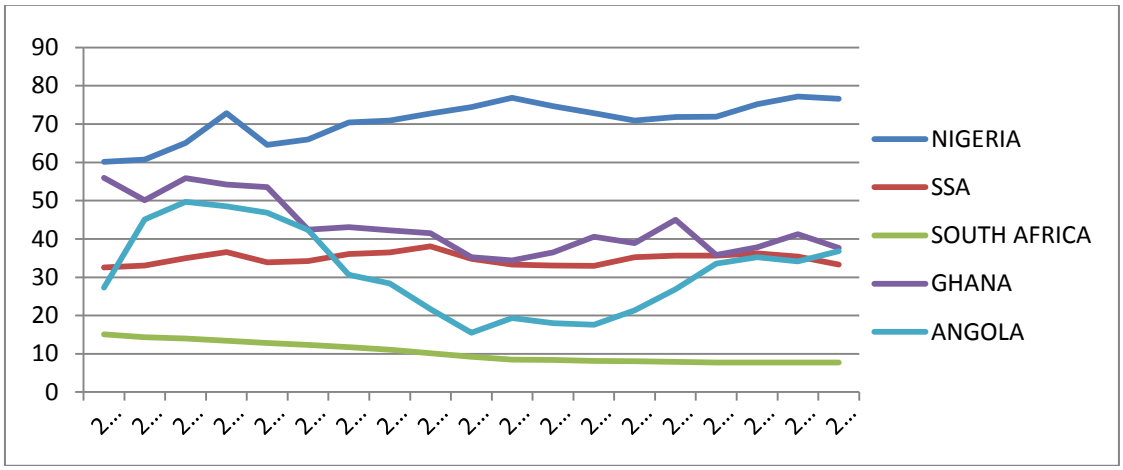

Fig. 1. Out-of-pocket expenditure (% of total health expenditure) 2000-2018
Source: Author's compilation with data from World Development Index (WDI) 2021

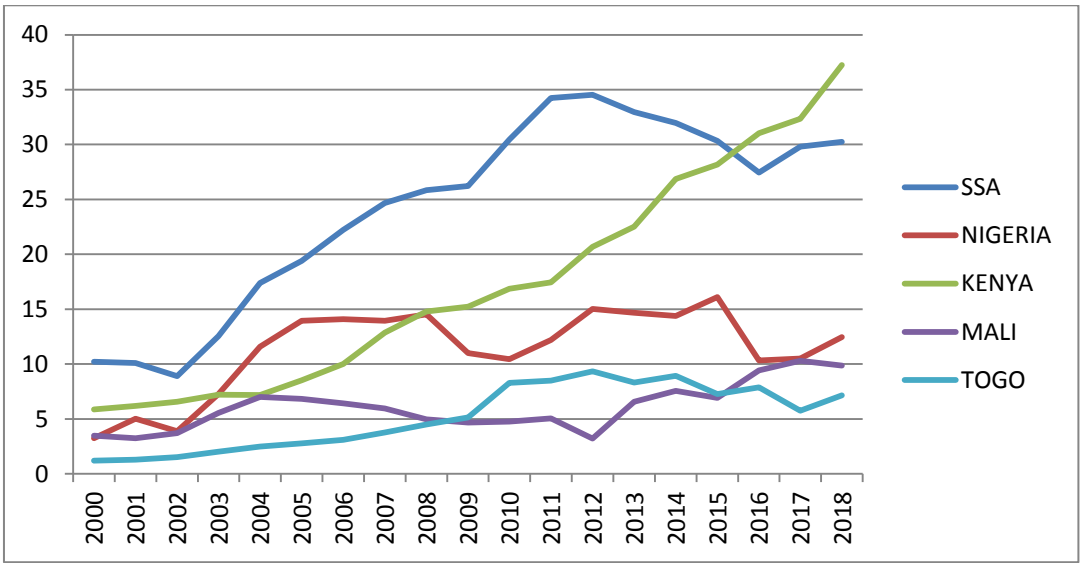

Fig. 2. Public Expenditure on Health 2000-2018

Source: Author's compilation with data from World Development Index (WDI) 2021

2.2 Theoretical Framework and Empirical Review

2.2.1 Theoretical framework

The theoretical understanding of the relationship between expenditure and growth is supported by the standard dynamic model of growth; the generalization of the models of economic growth, which is associated with the Keynesian model that describes the fractional dynamics of national income. In this model, Keynes recognizes the income is a primary determinant of spending by households if people had more income they would buy more goods and services, which in turn raise the level of aggregate demand. Similarly, an increased government spending raises aggregate demand and increases consumption. Keynes categorized public expenditure as an exogenous variable that can generate economic growth instead of an endogenous phenomenon Lingxiao, Peculea and Xu [9]. These linkages become a key piece of the complete macro model.

In the standard dynamical Keynesian model with continuous time,

$E(t) = C(t) + I(t) + G(t)$ Where,

$G(t)$ is the government expenditure; $C(t)$ captures the consumption expenditure; $I(t)$ describes the investment expenditure. All the variables describe the dynamics of the expenditure parts of the economy where $E(t)$ is a total expenditure, i.e., $E(t)$ is defined as the total of all expenditures.

2.2.2 Effects of public and private health expenditure on economic growth

Tae Kuen and Shannon Lane [2] analyzed the relationship between public health expenditure and national health outcomes among developed countries and data was collected from seventeen OECD countries between 1973- 2000. Infant mortality rate and life expectancy at birth were used as dependent variables and to analyze cross-country panel data, a mixed effect model was used. Government health expenditure and public health outcomes gave a statistically significant result and a positive relationship between government health expenditure and life expectancy at birth. Ali and Ogeto [10] investigated the effect of health expenditure on economic growth in Sub-Saharan Africa using the linear dynamic generalized method of moments instrumental variable (GMM-IV) on a panel data of 38 Sub-Saharan African countries over the period 2000-2016. Results revealed that health expenditure significantly improves economic growth in Sub-Saharan Africa. The Public and private health expenditures gave a significant positive relationship on economic growth as separate effects. In addition to health expenditure, other determinants like gross domestic saving, foreign direct investment, and labor force brought a statistically significant

improvement in economic growth. Weibo and Yimer [3] examined the effect of health expenditure on the selected health outcomes which included Life Expectancy, Infant Mortality, Under-Five Mortality, and Crude death in Sub-Saharan Africa. The linear dynamic generalized method of moments instrumental variable (GMM-IV) was used on a panel of 39 Sub-Saharan African Countries for the years 1995-2014. Results of this study showed that health expenditure significantly improves life expectancy and lowers infant mortality, under-five mortality & crude death in Sub-Saharan Africa. The separate effects of Public and private health expenditures have also shown a significant positive relationship on life expectancy and negative on infant mortality, under-five mortality & crude death. Behera and Dash [8] examined the dynamic relationships between public health expenditure and macroeconomic factors like economic growth, domestic revenue, domestic debt, fiscal balance, and central government transfer of 15 major states of India using the period 1990-2014. The empirical result showed that state revenue (i.e. tax revenue and indirect tax) and central transfer (i.e. tax devolution) are the major public providers for financing the health care of Indian states. The result suggested the improvement in revenue collection, increase in the tax base and the efficient utilization of central grants would generate fiscal space in the economy, and thereby the government can apportion additional funds toward public health care. Mpundu, Mwafulirwa, Chaampita, and Salwindi [6] explored the fundamental changes in public expenditure and the effect on the gross domestic product using an ARDL approach for time series data over the period 1980-2017. The control variables included foreign direct investment and current account balance. The objective was to determine changes that had occurred about the performance of GDP since 1980. Contrary to theory, increased government expenditure may not be ideal for growing the Zambian economy. Piabuo and Tieguhong [11] carried out a comparative analysis on the impact of health expenditure between countries in the CEMAC sub-region and five other African countries that achieved the Abuja declaration and found a long-run relationship exist between health expenditure and economic growth

3. METHODOLOGY

Specifically, the generalized method of moments (GMM) estimators for dynamic models of panel data introduced by Arellano and Bond [12] Arellano and Bover [13] will be employed and the data covered the period 2000-2019 for forty-six countries in sub-Saharan Africa and the data was derived from the ministry of health and World Bank Database.

3.1 Model Specification

Objective: Examine the impact of governmental and private health spending on Sub-Saharan Africa's economic growth.

Where;

GDP = f(PUHE, PRHE, GE, LEB,PGR)

nGDP_{it} = α_0 + $\alpha_1$ln $PUHE_{it}$ + $\alpha_2$ln $PRHE_{it}$ + $\alpha_3$ln GE_{it} + $\alpha_4$ln PGR_{it} + $\alpha_5$ln LEB_{it} + ε_{1it}

PGR stands for population growth, and LEB stands for life expectancy at birth, GE stands for government expenditure, PRHE is for private health spending and PUHE stands for public health spending.

"α_s" represent the coefficients of the regression equation, "α_0"are constants and"ε_{1it} **"** are the error term. GDP is Gross domestic product capturing economic growth,

H0: There is no significant relationship between public health expenditure and economic growth in Sub- Saharan Africa

4. RESULTS AND DISCUSSION

4.1 Summary Statistics for Africa

The basic statistical summary of the series under consideration for Africa, which includes the observation, mean, minimum, maximum, standard deviation and observations which are summarized in *table 1.* The variables under consideration are Gross Domestic Product per capita (GDP_PC), total health expenditure as percentage of GDP (THE_GDP), total health expenditure per capita (THE_PC), private health expenditure as percentage of GDP (PRHE_GDP), private health expenditure per capita (PRHE_PC), public health expenditure as percentage of GDP (PUHE_GDP), and population growth rate (PGR). From the *table 1*, it is shown that the mean or average GDP_PC is 2582.163 and the standard deviation is greater than the mean with a value of 3636.994 this indicates wide variations from the mean. The minimum value for GDP_PC 194.873 which is the smallest value in the series and the maximum value of GDP_PC is 20532.98 which is

the highest value in the series. Also, the mean value of THE_GDP is 5.222019 and the standard deviation is less than the mean with a value of 2.631536 this indicates that the value is close to the mean. The minimum value for THE_GDP is 0 which is the smallest value in the series and the maximum value of THE_GDP is 20.41341 which is the highest value in the series. The mean value of THE_PC is 100.1161 and the standard deviation is greater than the mean with a value of 176.7496 this shows evidence of wide variability from the mean value. The minimum value for THE_PC is 0 which is the smallest value in the series and the maximum value of THE_PC is 1552.573 which is the highest value in the series.

The mean value of PRHE_GDP is 3.559313 and the standard deviation is less than the mean with a value of 2.200293 this indicates that the value is close to the mean. The minimum value for PRHE_GDP is 0 which is the smallest value in the series and the maximum value of PRHE_GDP is 18.77272 which is the highest value in the series. The mean value of PUHE_GDP is 1.770474 and the standard deviation is less than the mean with a value of 1.176224, this indicates that the value is close to the mean. The minimum value for PUHE_GDP is 0.061829 which is the smallest value in the series and the maximum value of PUHE_GDP is 6.048561 which is the highest value in the series. Also, the mean value of PRHE_PC is 49.17891 and the standard deviation is greater than the mean with a value of 65.38921 this indicates that there is wide variability of the mean. The minimum value for PRHE_PC is 1.775926 which is the smallest value in the series and the maximum value of PRHE_PC is 409.989 which is the highest value in the series. Furthermore, the mean value of PGR is 2.381936 and the standard deviation is 1.026178 which indicate that the value is close to the mean. The minimum value for PGR is -2.62866 is the smallest value in the series and the maximum value of PGR is 5.604957 which is the highest value in the series. Also, the mean value of LEB is 58.22989 and the standard deviation is 7.78536 which indicate that the value is close to the mean. The minimum value for LEB is 39.441 is the smallest value in the series and the maximum value of LEB is 78.49756 which is the highest value in the series.

4.2 Unit Root Test

To avoid estimating a spurious regression, the unit root tests are presented in Table *2* so that the stationary condition of the series could be achieved before further estimation is carried out. In this study the Fisher, Phillip Perron (PP), Fisher Augmented Dickey Fuller (ADF), I'm-Pesaran-Shu (IPS) and Levin, Lin and Chu (LLC) unit root tests were conducted. Therefore, conducting a co-integration test to examine if a long run relationship exists among the variable is not necessary.

Table 1. Summary statistics for Sub-Saharan Africa

Variable		Mean	Std. Dev.	Min	Max	Observations
GDP_PC	Overall	2582.163	3636.994	194.873	20532.98	N = 920
	Between		7.220000	0.019700	36.40000	n = 46
	Within		2.390000	-14.00000	20.80000	T = 20
THE_GDP	Overall	5.222019	2.631536	0	20.41341	N = 920
	Between		1.94368	1.970528	12.19363	n = 46
	Within		1.795883	-6.97161	13.4418	T = 20
THE_PC	Overall	100.1161	176.7496	0	1552.573	N = 920
	Between		155.836	8.385778	795.9118	n = 46
	Within		86.35756	-695.796	856.7777	T = 20
PRHE_GDP	Overall	3.559313	2.200293	0	18.77272	N = 920
	Between		1.719084	1.313059	10.72892	n = 46
	Within		1.395399	-7.16961	11.60311	T = 20
PUHE_GDP	Overall	1.770474	1.176224	0.061829	6.048561	N = 864
	Between		1.061303	0.338403	4.32836	n = 46
	Within		0.517846	-0.50655	4.993501	T = 19
PRHE_PC	Overall	49.17891	65.38921	1.775926	409.989	N = 864
	Between		58.19169	3.955198	205.9202	n = 46
	Within		30.35218	-109.507	253.2478	T = 19
PGR	Overall	2.381936	1.026178	-2.62866	5.604957	N = 912

Variable		Mean	Std. Dev.	Min	Max	Observations
	Between		0.843842	-0.23318	4.231045	n = 46
	Within		0.594218	-2.47199	5.443138	T = 20
LEB	Overall	58.22989	7.78536	39.441	78.49756	N = 920
	Between		6.778112	47.1354	74.68518	n = 46
	Within		3.952073	46.01489	69.32824	T = 20

Source: Author's Computation

The Fisher PP unit root test result shows that the dependent variable LGDP_PC and independent variables LGDP_PC, PUHE_PC, LPUHE_PC, LLEB, and LGE are all non-stationary at the 5 percent level of significance. This implies that all the variables are integrated of order 1 and stationary at first differences. Similarly, the Fisher ADF unit root test result also shows that the dependent variable LGDP_PC and independent variable PUHE_PC, LPUHE_PC, PRHE_PC, LLEB and LGE are all non-stationary at the 5 percent level of significance.This implies that all the variables are integrated of order 1 and stationary at first differences. Im-Pesaran-Shin unit root test also observed that variables LGDP_PC, PUHE_PC, LPUHE_PC, PRHE_PC, LLEB, and LGE are all non-stationary at 5 percent level of significances. This implies that all the variables are integrated of order 1 and stationary at first differences. Also, LLC unit root test illustrations that LGDP_PC, LPUHE_PC, PRHE_PC, LLEB and LGE are all stationary at 5 percent level of significance except for PUHE_PC. Considering the results of IPS, Fisher ADF and PP, which show that the variables are integrated of order 1 and significant at 5 percent level, the study confirmed that the variables are non-stationary. Therefore, they are amenable for GMM and ARDL analyses.

4.3 Cointegration Tests for the GMM Model

Having established the order of integration of the series, this study employed both the Kao and Pedroni cointegration tests for the possibility *of long-run equilibrium between the variables under study. The test results are presented in* Table 3 below. The Pedroni test results for the model show that the null hypothesis of no cointegration in a group and panel for both PP and ADF can be rejected at a 1% level of significance. In addition, for the same model, the Kao test reveals that there is a co-integration and long-run relationship between all the variables at a 1 percent level of significance. The results of the Rho panel and group are all consistent with the assumption of cointegration among the variables. Overall, the hypothesis of no cointegration is rejected for the model based on the Kao cointegration test results and based on the Pedroni statistics for the panel, group, and Rho.

4.4 Presentation and Discussion of Results

The objective of this paper is to examine the effect of public and private health expenditure on economic growth in Sub- Sahara Africa.

4.4.1 Short-run effect of private and public health expenditure on economic growth

The short-run impact of private and public health spending on economic growth is depicted in this section utilizing the Generalised Moments Methods (GMM). The findings of one-step and two-step differences, as well as system dynamic panel GMM estimates, are presented. Table 4 shows the outcome of a one-step short-run differenced GMM panel data estimate. From the result, one lag value of LGDP_PC at a 1% level of significance, was discovered to be positive and significant, indicating that one lag value of GDP_PC has a direct effect on the current GDP_PC in the short run. The results of the difference GMM-1 step indicate that a percentage change in public health expenditure per capita (LPUHE_PC) is associated with a 0.1362% increase in GDP per capita (LGDP_PC) in the short run at a 5% level of significance, on average ceteris paribus. Although, a 1% change in public health expenditure per capita results in less than a 1% change in Real Gross Domestic Products (GDP_PC), an increase in government spending on health will improve economic growth in Sub-Saharan Africa in the short run. The AR (1) has a significant probability value as expected, while the probability value of AR (2) is not significant which shows The lack of a second-order serial correlation indicates that the lag of the dependent variables employed as instruments is not endogenous. The probability of the Hansen test (0.289) is not significant and it

indicates that the instruments are good. In summary, higher government health-spending will aid Sub-Saharan Africa's economic growth in the short run.

4.4.2 Short-run differenced GMM-2 dynamic panel data estimation

Table 4 presents the result of the two-step short-run differenced GMM panel data estimate. From the result, one lag value of LGDP_PC was found to be positive and significant at the 1 % level of significance, indicating that a one lag value of GDP_PC has a direct effect on current GDP_PC in the short run. The results of the difference GMM-2 step indicate that a percentage change in public health expenditure per capita (LPUHE_PC) is associated with a 0.1521% increase in GDP per capita (LGDP_PC) in the short run at a 5% level of significance, on average ceteris paribus. Even though a 1% increase in public health expenditure per capita results in a 1% increase in GDP per capita (GDP PC), The probability value of the AR (1) is 0.02 which is significant as expected, while the probability value of AR (2) is not significant which shows that there is a second-ordered serial correlation, The AR (2) infers that lag of the dependent variables used as an instrument is not endogenous. The probability of the Hansen test (0.289) shows that it is not significant and it indicates that the instruments are good. In summary, in the short run, increasing government spending on health will spur Sub-Saharan Africa's economic growth.

4.4.3 Short-run system GMM-1 dynamic panel data estimation

Table 4 showed the outcome of a one-step short-run GMM panel data estimate. From the result, one lag value of LGDP_PC at a 1% level of significance, was discovered to be positive and significant, indicating that one lag value of GDP_PC has a direct effect on the current GDP_PC in the short run. The results of the system GMM-1 step indicate that a percentage change in public health expenditure per capita (LPUHE_PC) is associated with a 0.0148% increase in GDP per capita (LGDP_PC) in the short run at a 1% level of significance, on average ceteris paribus. Although a 1% increase in public health expenditure per capita translates into a smaller than 1% rise in GDP per capita (GDP PC), an increase in government health spending will help economic growth in Sub-Saharan Africa in the short term. A percentage rise in current health expenditure per capita is also related to a 1.66353 percent increase in GDP per capita (GDP PC) in the near term at a level of 5% significance, on ceteris paribus average, according to the system GMM-1 step result. A one percent change in current health expenditure per capita results in more than 1% change in GDP per capita (LGDP_PC). The probability value of the AR of order 1 is 0.014 and shows it is significant while the probability value of AR of order 2 is not significant which shows that there is no second-order serial correlation which implies that lag of the dependent variables used as instruments is not endogenous. The Hansen Prob (0.393) is not significant and it indicates that the instruments are good. Thus, an increase in current health expenditure per capita and government spending per capita on health will improve economic growth in Sub-Saharan Africa in the short run.

4.4.4 Short-run system GMM-2 dynamic panel data estimation

Table 4 presents the result of the two-step short-run system GMM panel data estimate. From the result, one lag value of LGDP_PC was found to be positive and significant at the level of 1 % significance, indicating that a one lag value of LGDP_PC has a direct effect on current LGDP_PC in the short run. The results of the system GMM-2 step indicate that a percentage change in public health expenditure is associated with a 0.0109% increase in GDP per capita (LGDP_PC) in the short run at the level of 10% significance, on average ceteris paribus. Although, a 1% change in public health expenditure results in a less than 1% change in GDP per capita (LGDP_PC), an increase in government spending on health will improve economic growth in Sub-Saharan Africa in the short run. The probability value of the AR of order 1 is 0.006 which shows that the result is significant at order 1 while the probability value of AR of order 2 (0.164) is not significant which shows that there is no second-order serial correlation and this means that lag of the dependent variables used as instruments are not endogenous. The Hansen Prob (0.393) is not significant and it indicates that the instruments are good.

4.4.5 Long-run effect of private and public health expenditure on economic growth

This section shows the long-run effect of private and public health expenditure on economic

Table 2. Unit root analysis

Variables	Fisher PP		Fisher ADF		IPS		Remark
	Level	First difference	Level	First difference	Level	First difference	
LGDP_PC	116.630 (0.0524)	370.19 (0.000)	86.399(0.645)	211.37 (0.000)	3.721(0.999)	-7.012 (0.000)	I (1)
PUHE_PC	72.091 (0.938)	665.46 (0.000)	67.737 (0.973)	304.55 (0.000)	1.956 (0.975)	-11.194 (0.000)	I (1)
PRHE_PC	78.886 (0.871)	671.65 (0.000)	86.057(0.655)	259.45 (0.000)	0.389 (0.651)	-9.901 (0.000)	I (1)
LLEB	51.399(0.999)	146.13 (0.000)	73.616 (0.920)	1098.14 (0.000)	3.203 (0.999)	-28.576 (0.000)	I (1)
LGE	166.615 (0.100)	-12.504 (0.000)	109.008(0.084)	324.49 (0.000)	1.461(0.072)	-12.504 (0.000)	I (1)

The probability values are in parentheses
Source: Author's Computation

Table 3. Cointegration tests

		Pedroni Cointegration test					
Cointegration Test	KAO ADF Statistics	Panel PP-Statistic	Group PP-Statistic	Panel ADF-Statistic	Group ADF-Statistic	Panel Rho Statistics	Group Rho Statistics
	-4.2384	-13.6455	-7.4203	-3.4441	4.1967	5.7759	11.7075
	(0.0000)	(0.0000)	(0.000)	(0.0003)	(0.0023)	(0.0324)	(0.0145)

**** p<0.01, ** p<0.05, * p<0.1*
Source: Author's Computation

Table 4. Short-Run differenced & system (GMM-1 & GMM-2) dynamic panel data estimation

LGDP_PC	Diff GMM_1	Diff GMM_2	Sys GMM_1	Sys GMM_2
LGDP_PC_1	0.863515 (19.21)***	0.887258 (16.81)***)	0.96297 (43.07)***	0.955029 (31.67)***
LPUHE_PC	0.001362(2.36)**	0.001521(2.42)**	0.000148 (2.96)***	0.000109 (1.67)*
LPRHE_PC	0.000492(1.01)	0.000499(1.04)	-0.00021(-1.34)	-9.3E-05(-0.59)
LGE	0.00622(0.22)	0.005134(0.19)	0.00306(0.15)	0.013801(0.8)
PGR	0.033996(1.03)	0.021106(0.51)	0.027858(1.27)	0.003432(0.16)
LCHE_PC	-0.00432(0.18)	-0.00843(-0.36)	0.016635(2.01)	0.014591(1.36)
Hansen Prob	0289	0.289	0.393	0.393
Sargan test	19.56	19.56	30.24	30.24
Sargan Prob	0.297	0.297	0.035	0.035
Hansen test	19.72	19.72	18.97	18.97
AR (1) test	-2.4	-2.32	-2.46	-2.76
AR (1) P-value	0.017	0.02	0.014	0.006
AR (2) test	0.22	-0.03	-1.07	-1.39
AR (2) P-value	0.823	0.973	0.287	0.164
No. of Instruments	23	23	24	24
No. of Observations	634	634	620	620

*The Z statistics in parenthesis and *, **,&*** correspond to 10%, 5%, & 1% level of significance*
Source: Author's Computation

Table 5. Long-run differenced & system (GMM-1 & GMM-2) dynamic panel data estimation

LGDP_PC	Diff GMM_1	Diff GMM_2	Sys GMM_1	Sys GMM_2
LPUHE_PC	0.0099811 (2.16)**	0.01348999 (1.80)*	0.0039967 (2.51)**	0.0024135 (2.04)**
LPRHE_PC	0.0036053 (1.09)	0.0044218 (1.02)	-0.0055443 (-0.95)	-0.0020656 (-0.52)
LGE	0.0455754 (0.22)	0.0455329 (0.19)	0.0826226 (0.15)	0.3068859 (0.82)
PGR	0.2490789 (1.19)	0.1872018 (0.58)	0.7523152 (0.86)	0.0763205 (0.16)
LCHE_PC	-0.0316542 (-0.17)	-0.0747407 (-0.32)	0.4492342 (2.06)**	0.3244548 (2.24)**

*** p<0.01, ** p<0.05, * p<0.1*
Source: Author's Computation

growth using the Generalised Methods of Moments (GMM). It presents results of one-step and two-step difference and system dynamic panel data estimation. Table 4 presents the result of the one-step long-run difference GMM panel data estimate. From the result, LPUHE_PC is found to be positively significant at a 5% level. The result of the difference GMM-1 step indicates that a percentage change in public health expenditure per capita, in the long run, is associated with a 0.99811% rise in the growth of the economy at the level of 5% significance, on ceteris paribus average. Hence, public health expenditure per capita on economic growth exhibits a direct relationship, indicating that a 1% change in public health expenditure results in a less than 1% change in Real Gross Domestic Products (GDP_PC). In addition, a one percent change in the public health expenditure per capita has a larger positive effect on the GDP_PC in the long run-(0.99811%) than in the short-run-(0.13623%). In sum, a rise in government spending on health will improve (in the long run) Sub-Saharan Africa's economic growth.

4.4.6 Long-run difference GMM-2 dynamic panel data estimation

Table 5 presents the result of the two-step long-run differenced GMM panel data estimate. From the result, LPUHE_PC was found to be positively significant at a 10% level. The result of the difference GMM-2 step indicates that a percentage change in public-health expenditure per head, in the long run, is associated with a 1.34899% rise in the growth of the economy at the level of 10% significance, on ceteris paribus average. Hence, public-health expenditure per head on economic growth exhibits a direct relationship, indicating that a 1% change in public-health expenditure per head results in a more than 1% change in Real Gross Domestic Products (GDP_PC). In addition, a one percent change in the public health expenditure per capita has a larger positive effect on the GDP_PC in the long run (1.34899%) than in the short-run (0.1521%). Hence, an increase in government spending on health will improve (in the long run) Sub-Saharan Africa's economic growth.

4.4.7 Long-run system GMM-1 dynamic panel data estimation

Table 5 presents the result of the one-step long-run system GMM panel data estimate. From the result, LPUHE_PC and LCHE_PC at a 5% level of significance, are discovered to have a positive and significant influence on LGDP PC. The result of the system GMM-1 step indicates that a percentage change in public health expenditure per capita, in the long run, is associated with a 0.3997% rise in LGDP_PC at the level of 5% significance, on ceteris paribus average. Hence, public health expenditure on economic growth exhibits a direct relationship indicating that a 1% change in public health expenditure results in a less than 1% change in Real Gross Domestic Products (GDP_PC). In addition, a one percent change in public health expenditure per capita has a larger positive effect on the GDP_PC in the long run (0.39967%) than in the short-run (0.0148%). Furthermore, from the system GMM-1 step result, a percentage change in current health expenditure per capita in the short run is associated with a 44.92342% rise in economic growth at the level of 5% significance, on ceteris paribus average. Hence, current health expenditure per capita on economic growth exhibits a direct relationship indicating a 1% change in public health expenditure results in a more than 1% change in Real Gross Domestic Products (GDP_PC). In addition, a one percent change in the current health expenditure per capita has a larger positive effect on the GDP_PC in the long run (44.92342%) than in the short-run (16.635%).

4.4.8 Long-run system GMM-2 dynamic panel data estimation

Table 5 presents the result of the two-step long-run system GMM panel data estimate. From the result, LPUHE_PC and LCHE_PC are found to have a positive and significant effect on LGDP_PC at a 5% level. The result of the system GMM-2 step indicates that a percentage change in public health expenditure, in the long run, is associated with a 0.24135% rise in the gross domestic product at the level of 5% significance, on ceteris paribus average. Hence, public health expenditure on economic growth exhibits a direct relationship indicating that a 1% change in public health expenditure results in a less than 1% change in Real Gross Domestic Products (GDP_PC). In addition, a one percent change in government spending has a larger positive effect on the GDP_PC in the long run (0.24135%) than in the short-run (0.0109%). Finally, the result of the system GMM-2 steps, a percentage change in current health expenditure per capita in the short run is associated with a 32.44548% rise in the growth of the economy at the level of 5% significance, on ceteris paribus

average. Hence, current health expenditure per capita on economic growth exhibits a direct relationship indicating that a 1% change in current health expenditure per capita results in a more than 1% change in Real Gross Domestic Products (GDP_PC). More so, a one percent change in the current health spending per capita has a larger positive effect on the GDP_PC in the long run -(32.44548%).

5. SUMMARY, CONCLUSION AND RECOMMENDATION

This study examined the relationship between health expenditure and economic growth in sub-Saharan Africa. The General Method of Moments (GMM) was used to analyze the effect of public and private health expenditure on economic growth in sub-Sahara Africa. From the findings, it can be summarized that an increase in government spending on health would significantly improve economic growth in Sub-Saharan Africa in both the short-run and long-run. All health expenditure indices and real gross domestic products have a substantial link, according to the correlation study. The correlation coefficients for public health expenditure per capita, private health expenditure per capita, and government expenditure were all above 50%, indicating a strong link between these variables and real GDP. Public and private health spending were separated.

In conclusion, results of difference GMM-1 and GMM-2 steps indicate that a percentage change in public health expenditure per capita (LPUHE_PC) is associated with a 0.1362% and 0.1521% increase in GDP per capita (LGDP_PC) in the short run at 5% level of significance, on average ceteris paribus. Although, a 1% change in public health expenditure per capita results in less than a 1% change in Real Gross Domestic Products (GDP_PC), an increase in government spending on health care will improve economic growth in Sub-Saharan Africa in the short run. The result of the difference GMM-2 step indicates a one percent change in the public health expenditure per capita has a larger positive effect on the GDP_PC in the long run (1.34899%) than in the short-run (0.1521%). The results of the system GMM-1 and GMM-2 steps indicate that a percentage change in per capita public health expenditure (LPUHE_PC) is associated with a 0.0148% and 0.0109% increase in GDP per capita LGDP_PC) in the short run at a 1% level of significance, on average ceteris paribus. Although, a 1% change in public health expenditure per capita results in less than 1% change in GDP per capita (LGDP_PC), but in the short run, the increase in government spending on health will improve economic growth in Sub-Saharan Africa. The result of the system GMM-1 steps indicates that a one percent change in public health expenditure per capita has a larger positive effect on the GDP_PC in the long run (0.39967%) than in the short-run (0.0148%). The result of the system GMM-2 step indicates that a one percent change in government spending has a larger positive effect on the GDP_PC in the long run (0.24135%) than in the short-run (0.0109%).

The results of a GMM analysis(Generalized Method of Moment) of the short and long-run effects of private and public health spending on GDP show that spending on Public health per head has a positive impact on GDP. Ndaguba and Hlotywa [14] Tae Kuen and Shannon Lane [2] Ali and Ogeto [10], Mukui, Onjala, and Awiti [15] and Ibe and Olulu-Briggs'[16] studies are all in agreement with this finding. They all showed a strong and positive correlation between government investment in health and economic growth. Olayiwola, Bakare-Aremu, and Abiodun [17] found evidence of a long-term link between Public health spending and economic growth in Nigeria. Health spending has a significant impact on Sub-Saharan Africa's economic growth, according to Aboubacar and Xu [18]. This shows that increasing Sub-Saharan Africa's Public health investments can boost Short-term and long-term economic growth. Health spending boosts Sub-Saharan Africa's economic growth according to Ali and Ogeto [10]. Furthermore, using data from a panel of 38 countries in Africa (Sub-Saharan) from 2000-2016; the unique public and private health spending effects demonstrated significant and positive influences on economic growth. Ahmed and Hanif [19] also found a long-run relationship between public expenditure and the growth of the economy of 10 sub-saharan countries.

Based on the results of this study, the following are the recommendations;

The results of the short and long-run effects of private and public health expenditure on economic growth presented by the Generalized Method of Moments (GMM) showed that public health expenditure per capita has a positive effect on gross domestic product. This shows that if more investment is made into the public health care system by the government, there

would be more impact on the economic growth of the region so the government should increase budgetary allocations geared towards the health sector to at least 15%. This study also recommends the implementation of growth allied policies that will further enhance and encourage the economic growth of the private health care system to increase its impact on the economy as a whole.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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