Health Aid and Economic Performance in Sub-Saharan Africa: A System Generalized Method of Moments (SYS-GMM) Analysis

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ABSTRACT

This study examined the link between health aid and economic performance for 48 Sub-Saharan African countries from 2001-2020 by employing a modified "EPI index" as a proxy for capturing economic performance with set of control variables and used System Generalized Method of Moments (system-GMM) econometric technique for analysis. The data were collected from the Africa Development Bank and World Bank Development Indicators (WDI). We infer that health aid has a positive and significant link with economic performance in SSA countries. Hence, donors and the government of sub-Saharan Africa must integrate appropriate measures toward sustaining the maximization of health aid and improved economic performance.

Keywords : *Health Aid, Economic Performance, Life Expectancy, Health Expenditure, Sub-Saharan Africa.*

1. Introduction

Economic performance measures the aggregate short-run and long-run changes in an economy at the annual level (Broadberry & Wallis, 2017). It shows the improvement in health and wealth level through increased production, distribution and consumption of goods and services. Thus, part of the rationale of economic performance is to improve the social and material well-being of the people to attain the highest level of human development (African Economic Outlook (AEO), 2017**).** More so, health is a crucial economic asset employed in the course of production, consumption and distribution of goods and services, hence, its central role and share of contribution towards economic development have been buttressed at the global level, in line with the Millennium Development Goals (MDG) declaration's central focus. Hence, three (3) of the eight (8) MDGs concerned health: decreasing mortality among babies and children, improving maternal health, and eliminating malaria, HIV/AIDS, and other diseases. In essence, achieving these Millennium Development Goals (MDGs) requires financial resources for the provision of health infra-structure and services, which can lead to better health prospects that strengthen human capital and promote efficiency (Raghupathi & Raghupathi, 2020), and so contribute to economic growth. Given this understanding, the international community has committed significant resources to health support (which is also referred to as health development assistance (HDA) for sub-Saharan Africa and other nations that are developing due to the financial constraints experienced in these regions. Therefore, in SSA, the economy's development is dependent on the prudent use of health aid, as well as the equitable availability of medical facilities and infrastructure.

At the international summit on Financing for Development held in Monterrey, Mexico, which took place in March 2001, the Heads of State formally adopted this financial commitment. All signatory governments have committed to taking concrete steps to aid low-income countries in meeting the MDGs, and this agreement formalizes those commitments. This agreement was required to forestall failure to make significant progress toward achieving the goals by the deadline period. This effort was as a result of the unstable global health challenges and situation in many developing nations, including sub-Saharan Africa (Kébré, 2018). Although, some developing economies have made progress in both human and economic growth since the turn of the millennium thanks to health aid financing, many countries in sub-Saharan Africa (SSA) are still falling far behind in key areas like health, education, and the availability of clean water, nutritious food, and modern sanitation, despite the increase in health aid to the region.

Hence, notable studies have examined aid (Official Development Assistance (ODA)) and economic growth particularly in SSA without examining, to the best of our knowledge, the relationship between health aid (Development Assistance for Health (DAH)) and

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economic performance despite the rising health aid and low economic performance in the region**.** Besides, Per capita income (PCI) or GDP per capita has been utilized as a proxy for economic performance in studies examining the link between health aid and growth, health aid and health outcomes, and inequality in health and growth, especially in SSA (Filmer & Pritchett, 1999; Smith & Haddad, 2002; Grimm, 2010; Subramanyam et al., 2011; Harttgen et al., 2013; Vollmer, Harttgen et al, 2014; Rahman et al., 2018; Sterck et al., 2018 and Bustamante & Shimoga, 2018) The use of PCI or GDP per capita as a proxy for economic performance has been criticized because it disregards the long-term importance of growth in economic, natural, and social capital assets, that is, factors that determine people's well-being such as the worth of non-market goods and services are not considered, and prioritizes immediate economic activities over those aforementioned assets (Van den Bergh, 2007). Hence, some studies used a composite variable "Economic Performance Indicators" (EPI) as proxy for economic performance both in developed and emerging economies (Khramov & Lee, 2013; Anand et al., 2015). As far as we can tell, there is no published research using the EPI index as a stand-in for economic performance in SSA. In this analysis, economic performance was quantified using a tweaked version of the "EPI index" as a stand-in for reflecting SSA's economic landscape. Against this backdrop, this paper examines the effects of health aid on economic performance in SSA countries using a robust panel data analysis. The remaining part of the paper is structured into four sections. Section 2 is on related literature review while section 3 focuses on methodology used in the study. Section 4 is on results and the discussion of findings, while section 5 concludes the paper.

2. Literature Review

2.1. Theoretical Review

2.1.1 The Neoclassical Growth Theory (Solow Growth Model)

The Neoclassical Theory of Growth is an alternative to and refinement of the Harrod (1939) and Domar (1946) model of economic growth. Its an economic growth model that describes how labour, capital, and technology all work together to produce a constant economic growth rate. They theorized that the rate of population expansion and the rate of technological progress were two exogenous variables that governed long-term growth rates of output. In this case, expansion is unconnected to the savings rate or government intervention. According to the proponents of this idea, a country's economic growth is determined in large part by the rate at which its citizens accumulate and put to use capital. It also states that the relationship between labour and capital determines an economy's output. The idea also suggests that technological advancements improve labour productivity and total output by making workers more efficient. Economic growth and stability can be quantified with the use of the neoclassical growth model's production function. Thus, if the three components of the neoclassical model of economic growth (labour, capital, and also technology) are not all equal, the earnings of both capital and labour on an economy will decline (Swan, 1956; Solow, 1957). If savings, depreciation, workforce growth, and productivity growth are all constant, then the model predicts that all economies will eventually reach a similar level of income.

The growth model developed by Solow (Solow, 1956) serves as the key framework for studying the phenomenon of cross-country convergence. The basic improvement in this model over the Harrod-Domar model is that it allows for substitutability between capital and labour since Harrod-Domar model basically assumes only capital when used effectively, can increase production. Therefore, the Solow growth model considers the possibility of declining returns on investments in both capital and labour. The following are some of the assumptions made by the model: Only one composite good is manufactured; depreciation of capital is subtracted from gross output to arrive at net output; the production function is first-degree homogenous, meaning that there are constant returns to scale; both labour and capital are compensated based on their marginal physical productivities; both input factors are being used to their maximum capacity; capital and labour can be replaced by one another; the rate of savings remains unchanged and regular advances in technology can be observed. Prof. Solow uses these premises in an attempt to demonstrate that the capital-labor ratio tends to rebalance itself over time in the direction of the equilibrium ratio, even when the technical coefficient is changeable. Capital and production will expand more slowly than the labour force if the capital-to-labor ratio is higher to begin with. According to the model, to achieve sustained growth, it is necessary that investment increases at such a rate that capital and labour productivity grow proportionately. This, in other words, is the stable growth. Stable growth typically results in proportional expansion of the equilibrium channel (capital and labor) (Solow, 1956). Growth in the capital-to-labor ratio, k (also called capital deepening), is calculated using the Solow equation, which also demonstrates that k's growth is contingent on the level of savings, sf(k). The steady state can be calculated using the Solow equation, once the necessary capital depreciation (δk) and capital broadening (giving the current quantity of capital available per worker to the net workers entering the labour force, nk are taken into account. Invariably, it also focuses on and ties growth to human capital, which requires an individual's health for maximum productivity. Foreign aid is viewed as the transfer of income to developing countries by the Solow growth model, allowing for the creation of savings for

development-inducing investments, and it is also a model that explains the modern economy in terms of capital accumulation, labour or population growth, and increases in productivity, all of which are required to provide a realistic approach to growth and development in SSA.

2.1.2 The Two Gap Model

The 'two gap model,' developed by Chenery and Strout in 1966, is the accepted and foundational model used to justify aid. This model presupposes (a) that aid is used to finance investments and (b) that the connection between investments and economic growth is linear and steady. The first discrepancy is between the total amount of domestic savings and investment required to reach and maintain a target rate of growth. The second type of gap is the foreign exchange gap or trade gap, which occurs when import demands for a certain level of productivity surpass foreign exchange earnings (the import-export gap). The idea behind the twin gap study is that the "saving-gap" and the "foreign exchange gap" are two distinct and unrelated obstacles to economic development in LDCs like sub-Saharan Africa. Insignificant as the saving-investment difference may be, a larger trade deficit may restrict productive investment by preventing the country from importing enough capital goods. As a result, the inability to accumulate sufficient national savings (savings gap) plus the inability to accumulate adequate money in other currencies (exchange rate gap) might be mitigated by receiving foreign resource inflows, such as aid (Serieux, 2009). One could argue that foreign aid is justified since aid recipients have a specific need at this moment. The investment-limited growth theory is supported by the 'two gap analysis,' which is based on the Harrod-Domar model and postulates a certain level of investment to improve growth (Kabete, 2008). A developing economy will be forced to choose between these two chasms. If a country's saving gap is especially large, for instance, domestic investment is likely a limiting factor for economic growth there. Consequently, it is possible to supplement domestic savings with international savings and foreign aid. When there is a significant foreign exchange imbalance, however, a developing economy's productive resources (primarily labour) are in excess, and all readily available foreign exchange is primarily spent on imports. However, if a country does not have sufficient reserves of foreign currency to launch a new investment project, it must find external finance, making it clear that foreign aid plays a vital role. In order to generate preliminary projections of the relative effect of foreign aid on growth and investment in developing nations, the two-gap model was used.

If investment is constrained by liquidity but favourable justifications exist, then the assumption that development aid fills these gaps is valid. This shows that aid will not stimulate investment but will instead increase consumption if poor incentives are the cause of low investment (Workneh & Francken, 2015). Investment returns are another indicator of development aid's success in closing these disparities (White, 1992). This is due to the fact foreign direct investment performs a significant role in economic development since it provides financial resources, technological spillover and human capital improvement. Hence, aid dependency by developing countries has been maintained as a result of other factors besides the dual gap analysis outlined above. These factors include low technology, substandard education, inadequate socioeconomic amenities, population explosion, and payments of interest on external loans and political instability (in some nations) (Kabete, 2008). Easterly (2003) and Bender (2005) both found fault with the two assumptions, arguing that if the non-substitutable assumption fails, the link between investment & foreign aid might not be linear. Foreign assistance may be used to prop up domestic consumption because the model disregards the distribution of resources plus the importance of how efficiently those resources are utilized. As the economy improves, domestic savings will fill the first gap, which is a binding limitation during the start of the growth process because the saving rate is expected to rise as a result; the second gap will be occupied by investment because the rate of investment, which is a result of economic growth, is likely to exceed the earnings discovered through exportations to pay for it.

Nevertheless, despite criticisms of the dual theory on the grounds that aid is channeled into consumption rather than investment and that aid may have undesirable side effects, sub-Saharan African (SSA) economies can achieve the desired growth rate by making sure the savings gap is satisfied by foreign aid, therefore the theory remains very important in this context. Like how there is assumed to be a constant connection between the amount of necessary intended foreign exchange and net export earnings. As stated by (Kolawole, 2013), foreign aid can be used to fill the foreign exchange gap that occurs when net export profits fall far short of foreign exchange needs.

2.1.3 Three Gap Model

The fiscal gap, trade gap, and saving-investment gap are the three gaps in the three gap model. The fiscal gap refers to the difference that exists between government revenue and planned expenditure, even though it is a form of the saving gap. As a result of this fiscal imbalance, government efforts aimed at boosting private investment could be restricted when the resources of the government meant for investment and imports are not sufficient due to loan servicing, among others. There is sufficient evidence indicating that foreign debt service has reduced government expenditures in sub-Saharan African nations despite efforts by highly indebted poor income countries (HIPICs). Thus, the filling of this fiscal imbalance could be aided by foreign resources channeled towards the budget

of government. But if the assistance is given as a loan instead of a grant, it could hurt long-term savings, foreign exchange, budget gaps, and macroeconomic performance. For example, payment of debt raises requirements for both foreign exchange and regular government revenue. Hjertholm (2000) echoes this idea when he says, "a financial aid flow might replace the gap in trade now, however a more rapid rate of expansion of exports is needed for the country to become self-reliant of foreign inflow in the foreseeable future". Additionally, debt service can reduce the government's import capacity, lowering government investment in social amenities, education and health infrastructure, a determinant that could possibly have negative impact on private investments (Kabete, 2008). According to the three-gap model, the effect of fiscal constraints on government expenditure and, by extension, its social investment options, constrains employment and the expansion of existing productive capacity, just as Chenery and Strout (1966) had previously concluded on the basis of the dual gap model. In the scarcity of enacted financial markets, the potential options for funding social investment are primarily constrained to external borrowing, surplus budgets and inflation. External resources can perform a notably important function, particularly if reducing ongoing spending and inflation-based funding are impossible, either due to political state of affairs or to foreign forces on the fiscal powers to reduce inflation (Sepehri & Akram-Lodhii, 1999).

2.1.4 Endogenous Growth Model

In response to the shortcomings associated with the Solow-Swan neoclassical model of growth, the Endogenous Growth Model was formulated. Endogenous forces, as opposed to the exogenous factors relied on by the neoclassical growth theory, are thought to be responsible for an economy's expansion in this framework. According to the Solow-Swan growth model, the saving rate is irrelevant to the long-term rate of growth of output, which is reliant on two exogenous factors: the rate of population expansion and the pace of technical progress. This demonstrates that the neoclassical viewpoint has had constrained policy implications, as the long-term growth rate is determined by exogenous factors. The endogenous growth theory, on the other hand, does more than only criticize the neoclassical growth theory; it also expands it by including endogenous technical advancement in growth models. The theory places greater weight on technical advancement as a result of a nation's investment rate, capital stock size, and human capital. The following are some of the common assumptions used by models of endogenous growth: Knowledge or advances in technology is a non-rivalry good; there are numerous business organizations in a market; a technological advancement stems from the actions of the people, i.e. innovations; there are increasing returns to scale with regards to all factors taken jointly and a constant return to no less than one factor; several people and firms have market profits and power from their discoveries.

Basically, one endogenous growth model used in literature to underpin the study on foreign aid and human capital development is Barro growth model presented by Prof. Robert J. Barro in his study titled 'Government Spending in a Simple Model of Endogenous Growth' in 1990. This study is simply an extension of Romer (1986) growth model, thus, it is a simple model of endogenous growth with government. In the Barro model, public spending are utilized for public investment and this public spending are financed through income taxes. The public investment complements the private investment by increasing the productivity of the private investments. Barro model suggested that growth rate and saving rate fall with an increase in utility-type expenditures (productive government expenditure), that is, the rate will increase initially, but will fall subsequently as a result of productive government expenditure. However, the theory disregards the importance of institutions and fails to differentiate and clarify between physical capital and human capital, both of which are necessary for economic growth when human capital is represented in physical capital (Jhingan, 2010).

2.2 Empirical Review

Few strands of literature have emerged with mixed results and conclusions on the relationship between health aid and economic growth (performance) in various economies. Also, while some studies are on specific countries analyses, others are on sub-regional and regional analyses. In this section, we focus on the review of some of these studies and their major findings. For instance, McGillivray (2004) surveyed and reviewed the patterns of ODA in SSA and the Pacific region since 1960, drawing attention to a decrease in the 1990s empirical studies on the efficacy of aid at the macro level and truly concentrating on research studies of these inflows with economic growth. The results showed overwhelming evidence that official development assistance raises growth and other poverty-related variables. The study concluded that without aid, poverty could be elevated and the MDGs are more difficult to achieve as a result of this downturn.

Unrelatedly, Gomanee, Girma, and Morrisey (2005), for example, used Residual Generated Regressors and Pooled Panel outcomes to examine the entire influence of aid on growth, after considering its effect via investment, for twenty-five nations in SSA from 1970 to 1997. All things being equal, the study found that aid significantly boosted economic development. Increasing the ratio of aid to GDP by one percentage point has been found to improve GDP by about a quarter of a percentage point on average. Thus, the study found that inefficient aid could not account for

Africa's historically low growth rates. Additionally, Hlavac (2007) used panel data and the regression approach with multilateral assistance inflows as a percentage of GDP as the dependent variable and measures of health, education, and the quality of government and other institutions as the explanatory variables to investigate the multilateral determinants of aid influxes in twenty-two SSA countries between 1995 and 2004. According to the results, countries with lower health and education indicators receive a greater share of multilateral aid as a percentage of GDP, while corruption, determined by the International Country Risk Guide (ICRG), appears to be a relatively minor factor in the distribution of multilateral official development assistance. Using fixed effects and system GMM econometric methods, Ziesemer (2012) investigated the impact of development aid on educational and healthcare indicators in 65 nations with low incomes from 1960 to 2010. Growth rates in aid per capita were found to have a sizable and positive effect on growth rates in life expectancy, while aid growth per capita rates or levels were found to be likely to reduce growth rates in Illiteracy. Also, Feeney and Ouattara (2013) used panel data econometric techniques to investigate the impact of health development aid on child health-promoting in developing countries, specifically focusing on measles and also diphtheria-pertussis-tetanus (DPT) immunization rates between 1990 and 2005. Health aid and promotions to improve children's health were found to have a statistically significant and favorable correlation**.** On the contrary, Harttgen, Klasen, and Vollmer (2013)) used regressions with country fixed effects measure to look at how the GDP per capita affects health outcomes in SSA by using child stunting, underweight, and wasting as stand-ins for health outcomes. The data showed that there was a moderate link between GDP per capita and the number of undernourished children. Also**,** Mallaye and Yogo (2013) looked at 34 countries in sub-Saharan Africa between 1990 and 2010 and analyzed the effectiveness of aid using the Oaxaca-Blinder decomposition approach. The study found that health aid only had a beneficial effect on growth after controlling for governance, highlighting endogeneity of health aid. Meanwhile, Salami, Stampini, Kamara, Sullivan and Namara (2014) used a novel Watsan Index of Development Effectiveness (WIDE) analysis to examine the connection between development aid and access to sanitation and water in four nations: Kenya, Madagascar, Burkina Faso, and Uganda from 1990 to 2008. As shown by the data, between 1990 and 2008, the percentage of people in SSA who had access to better water sources went from 27% to 49%, or less than 1% year. More so, Irfan and Nehra (2016) used dynamic data modeling with the GMM econometric approach to explore the effects of categorized aid for development on the health condition and the standard of people living in the urban sector of eight (8) different Southeast Asian Countries within 2002-2012. Based on their research, it appears that health-related development aid has not been very helpful in improving the health of urban populations. Furthermore**,** To examine the impact of aid on a group of 25 sub-Saharan African countries from 1970 to 2012, Tait, Siddique, and Chatterje (2016) used fixed effect panel data analysis. Their study found that health aid had a significant and beneficial effect on growth when they performed a sectoral decomposition encompassing the sub-period 1995–2012. When compared to the results obtained from 1970 to 2012, which offered a unique view into the effect of aid on growth by sector and advice for policymakers on aid allocations in sub-Saharan Africa, these results fall short. Also**,** Nwude, Ugwoke, Uruakpa, Ugwuegbe, and Nwonye. (2020) used a dynamic two-step system-GMM to examine the effects and link between ODA, GDP per capita, and health outcomes in 81 countries that are developing from 1998 to 2017. Health outcomes in sub-Saharan Africa (SSA) were found to be comparable to those in other developing countries, and the effect of income per capita on health outcomes in SSA was found to be comparable to that in non-SSA. However, a significant distinction was discovered between SSA and non-SSA in terms of the impact of official development assistance on health outcomes. The study also found, surprisingly, that official development assistance has a less impact on life expectancy in SSA than in non-SSA. Official development assistance has a greater impact on mortality among children under five in SSA than in non-SSA areas. Additionally**,** Mohamadianmansour (2020) used the Dynamic Ordinary Least-Squared (DOLS) estimator to examine long-term associations between health indices and GDP proportion of official development assistance and health assistance, per capita physician, income, level of education, and urbanization in 25 developing nations from 1955 to 2017. According to the study's findings, health indicators like Gross Domestic Product (GDP), Per Capita Physician Expenditures (PCPE), Per Capita Income (PCI), Secondary School Enrollment Rates (EIR), and Urbanization Rate (URR) improve over the long term. The infant mortality rate (IMR) in underdeveloped nations would drop by 0.18 percent if health aids made up one percent of GDP. However, the health index is not significantly affected by the ratio of official development assistance to GDP. Therefore, the study suggested that health aid in countries that are developing should be used and managed correctly to help boost health outcomes.

3. Methodology

In order to examine the effect of health aid on economic performance in sub-Sahara African countries, the study employs the system generalized method of moment (sys-GMM) dynamic panel estimator. We estimate a variant of the equation below in line with Blundell and Bond (1998) and by adopting the specification of Negeri and

Helemariam (2016) and Nwude (2020). The model is stated based on the nature of study and data availability in the functional form thus :

$$EPI = f(HAID) \quad \text{.....(1)}$$

Introducing other control variables used in these studies, equation (1) becomes:

$$EPI = f(HAID, LEXP, HEXP, HAP) \quad \text{.....(2)}$$

Econometric form as:

$$EPI_{i,t} = \beta_0 EPI_{(i,t-1)} + \beta_1 HAID_{i,t} + \beta_2 LEXP_{i,t} + \beta_3 HEXP_{i,t} + \beta_4 HAP_{i,t}\, \mu_{1(t)} + \mu_{2(t)} + \beta_{i,t} \quad \text{.....(3)}$$

Where EPI is economic performance index as proxy for economic performance, HAID is Health aid which serves as the main explanatory variable in the model with its imperative inclusion as operationalized by Mishra and Newhouse (2009), Drabo and Ebeke (2011), Mallaye and Yogo (2015), Odokonyero et al (2015) and Ndikumana and Pickbourn (2018) while LEXP is life expectancy and it was included in the model because it is a sensitive health indicator of a country's socioeconomic and health status (Spinakis et al, 2011). HEXP is health expenditure included in the model to assess health fund available for health care provision towards reducing health inequality and HAP is HIV/AIDS prevalence and was included as control variable (Hsiao and Emdin, 2014; Kébré, 2018). β_0 is constant and β_1- β_4 are parameters estimates, $\mu_{1(i)}$ and $\mu_{2(t)}$ represent country and time effects respectively while $\varepsilon_{i(t)}$ is an idiosyncratic error term with $E(\varepsilon_{it}) = 0$ for i and t

For the purpose of analyzing the dynamic relationship between health aid and economic performance as specified in equation (3) above, and for robustness check, the generalized method of moments (GMM) estimators were used. Specifically, the difference-GMM developed by Arellano and Bond (1991) was used for two-step. The Hansen statistic developed by Hansen (1982) which is the minimized value of the two-step GMM function, is robust and used in this study to test for identifying restrictions and the validity of the instruments. For this purpose, it is expected that the p-value of the Hansen test should range between 0.1 and 0.25. More so, Roodman (2009) recommends that the number of instruments should not outnumber the cross-sections (that is, countries). Another very necessary condition for the difference GMM is that the error term does not have second-order autocorrelation; otherwise the standard error of the instrument estimates grow without bound (Doytch & Uctum, 2011). Therefore, the presence of second-order serial correlation is confirmed based on the value of AR (2) which is generated by default using the xtabond2 command in STATA. If the p-value of AR (2) is significant, then there is problem of second-order serial correlation.

The annual data used in this study covered the period 2001 to 2020 for 48 sub-Sahara African countries. The variables in this study include health aid (source, OECD Creditors' Reporting System (CRS), 2020)), economic performance index (source, Africa Development Bank (ADB) and World Development Indicators (WDI) of the World Bank, (2020), life expectancy (source, World Bank, (WDI),2020)), health expenditure (source, World Bank, (WDI), 2020) and HIV/AIDS prevalence measured as cases per 100,000 individuals (source, World Bank, (WDI),2020)

4. Results and Discussions

In order to examine the effect of health aid on economic performance in sub-Saharan Africa, the study first determined the best appropriate model estimator for the model using the Durbin-Wu-Hausman test. The null hypothesis of the random effect model is more appropriate and was tested against the alternative hypothesis that the fixed effect model is more appropriate. The result of the Hausman test in table 1 clearly showed that the Chi-square

Table 1 : *Robustness Check on the Effects of Health Aid on Economic Performance in Sub-Saharan Africa*

Dependent Variable: EPI						
Variable	**Fixed Effect Model**			**Random Effect Model**		
	Coefficient	**Std. Error**	**Prob.**	**Coefficient**	**Std. Error**	**Prob.**
LnHAID	-1.30065	0.8484827	0.126	0.3269154	0.193148	0.091
LEXP	-0.1772934	0.1780977	0.320	-0.086038	0.0640827	0.179
HEXP	0.9215546	0.4095715	0.025	0.2605826	0.2444954	0.287
HAP	0.6456607	0.5737085	0.261	-0.4233299	0.0938195	0.000
Hausman Test						
Chi-Sq. Statistic	124.40					
Prob.	0.000					

Source : *Authors' Computation, 2023*

Table 2 : *Results of System-GMM Dynamic Panel Model on the Effects of Health Aid on Economic Performance in SSA*

Dependent Variable: EPI				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob**
EPI(-1)	0.4616812	0.0953092	4.84	0.000
LnHAID	0.8134118	0.3035894	2.68	0.010
LEXP	-0.2304455	0.1175678	-1.96	0.057
HEXP	-0.1233836	0.2782618	-0.44	0.660
HAP	-0.7264023	0.1822406	-3.99	0.000
C	55.75578	10.50245	5.31	0.000
Number of Observations	726			
Number of groups	43			
Number of instruments	7			
F-test of Joint Significance	2771.33 (0.0000)			
AR (1)	0.011			
AR (2)	0.932			
Sargan test	0.101			
Hansen test	0.424			

Source : *Authors' Computation, 2023*

value is 124.40 and the probability value is approximately 0.01 which is less than 0.05 percent significance level, thus, it means that the fixed effect is more appropriate for our model. The results affirmed that we accept the alternative hypothesis that the fixed effect model is more appropriate, hence, we accept it.

Table 2 presents the Panel two steps system Generalized Methods of Moment (GMM) to examine the effect of health aids on economic performance in Sub-Saharan Africa. From the result, a percentage change in one lag of economic performance is associated with an approximated 0.46 increase in the contemporaneous economic performance at the 1% significant level, on average ceteris paribus. Hence, one lag economic performance (EPI (-1)) exhibits a direct relationship with contemporaneous economic performance in Sub-Saharan Africa. Also, health aid (HAID) has positive and significant effects on economic performance (EPI) in Sub-Saharan Africa. Thus, a percentage change in health aid (HAID) brings about approximately 81.3% significant increase in economic performance in sub-Saharan Africa. On the contrary, life expectancy (LEXP), health expenditure (HEXP) and HIV/AIDS prevalence (HAP) all have negative effect on economic performance (EPI) in sub-Saharan Africa, with HIV/AIDS prevalence being significant. Thus, a percentage change in life expectancy (LEXP), health expenditure (HEXP) and HIV/AIDS prevalence (HAP) bring about approximately 23.0%, 12.3% and 72.6% decrease in economic performance respectively, however, health expenditure (HEXP) is not significant to influence economic performance in sub-Saharan Africa.

Post Estimation Assessments

Auto-serial correlation test: In the GMM framework, it is essential to assess the presence or otherwise of first order serial correlation in the idiosyncratic error term popularly known as AR (1) test. From table 2 above, the AR (1) p-value of 0.011 is less than 5 percent, therefore, the null hypothesis which stated that "there is no first order autocorrelation in the idiosyncratic error term" was rejected. In the theory of the GMM analyses, the rejection of the null hypothesis of the AR (1) test is inconsequential as it conveys no special message. However, the null hypothesis of the AR (2) test which was "no second order serial correlation" was accepted due to the higher p-value of 0.932. This aligned with expectation in order to ascertain the validity of the empirical model. Therefore, considering the results of AR (2) test, it shows that our model does not suffer from autocorrelation (Prob > 0.05), hence, these results support the validity of the model specification.

Validity of the instrumental variables: In order to establish the consistency of the estimates obtained in GMM estimation, the instrumental variables must have overall validity. The Sargan and Hansen tests are both tests of over-identifying restrictions, which test the validity of the

instrumental variables. The null hypothesis was that "all instruments as a group were exogenous or were valid". The probability value of the Sargan and Hansen tests in table 2 are 0.101 and 0.424 respectively indicating that the instrumental variables were valid (prob > 0.05) for sub-Saharan Africa.

Joint significance of variables of the model: The F-statistics is used to check the joint significance of a model's independent variables on the dependent variable. The F-statistic is significant at 1% with a value of 2771.33 indicating that all the explanatory variables jointly had a significant influence on economic performance as shown in table 2 above. Thus, the estimated model can be trusted in making valid inference in sub-Saharan Africa.

5. Conclusion and Recommendations

Based on the findings of the analysis of the relationship between health aid and economic performance in sub-Saharan Africa, health aid has been observed to have significant effects (positive) on economic performance in SSA. It can be concluded that the increase in the level of health aid has been effective in improving the standard of living in sub-Saharan Africa. Hence, the government of sub-Saharan Africa should integrate appropriate measures towards sustaining the maximization of health aid and improved economic performance while the governments of SSA and donors must ensure that health aids are not only directed towards the provision of health infrastructure and services but are judiciously used for improved life expectancy, reducing the level of infectious diseases and its impact to be more felt in the region. This will guarantee not only an improvement in the standard of living but also in the socioeconomic well-being of the people of the SSA region.

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