Effectiveness of External Financing on Health Infrastructure in Sub-Saharan Africa Countries

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Abstract
Healthcare systems in both the developed and developing worlds have been put under unprecedented strain as a result of the COVID-19 pandemic, with demand outstripping supply while health facilities have been grossly inadequate most especially in SSA. However, most SSA countries lack the resources and capability to provide the necessary health facilities needed to enhance the population health and the entire health system, thus, there is need to complement this with the alternative such as external financing. Because of this, this study examines the effectiveness of external financing and other postulated determinants on health infrastructure in SSA for the period of 2000 to 2018 by employing Panel-Corrected Standard Error (PCSE) for analysis of the model. The results of the findings indicate that external financing as whole has positive effects on health infrastructure, while private participation in infrastructure and official development assistance have positive effects on health infrastructure, foreign direct investment has negative effects. Consequently, the study recommends that both private participation in infrastructure and official development assistance should be considered as the instruments for promoting health infrastructure while the authorities involve should desist from using foreign direct investment for promoting health infrastructure.

Keywords: Health, Infrastructure, external financing, domestic financing

Jel Classification Codes: I15. I18

1.0 Introduction

Infrastructure is essential to basic functioning of modern society and without the critical infrastructure services such as high quality health care facilities, education, transportation systems, high-speed telecommunications services and proper sanitation facilities, human activities would have been more difficult (Yates, 2014). Infrastructure complements capital and labour as a production input by providing services that are part of people's consumption bundles (Ayogu, 2007). Poverty, unemployment, regional imbalances, bad livelihood, illiteracy, and poor health are some of the barriers that improved infrastructure can overcome, all of which are obstacles to national development (Kumari & Sharma, 2017).

The development of a country's health sector necessitates efforts in a variety of areas, including health infrastructure, health service funding, and formation of a health guarantee system, health delivery systems, and health workforce enhancement. Healthcare systems in both the developed and developing worlds have been put under unprecedented strain as a result of the COVID-19 pandemic, with demand outstripping supply. Since the outbreak of Coronavirus, specifically during the global lockdown, most countries of the world banned or limited the export of face masks, protective gear, gloves and other medical equipments to mitigate

shortages. Confronted with the travel restrictions and limited importation of medical facilities, the country's own healthcare facilities should be prioritized (World Trade Organization, 2020).

However, despite this indisputable evidence of the significance of health care to the nation's development, the provision and maintenance of quality, accessible and affordable healthcare has been an uphill task for many nations in the world, though the developing countries are more affected most especially Sub-Saharan African countries (SSA). Evidence has shown that there is no region in the world that lacks infrastructure and need urgent infrastructure development more than the SSA region (Foster & Briceno-Garmendia, 2010). The major sources of financing infrastructure by the SSA countries have been from the internal (public funds as captured in annual capital budgets) and external sources (foreign direct investment, private participation in infrastructure and official development assistance) particularly after 2005 (ICA 2010), even though domestic financing remains the primary source of financing infrastructure. However, most SSA countries lack the resources and capability to provide the necessary health facilities needed to enhance the population health and the entire health system (Hammami, Rushashyankiko & Yehoue, 2006; Hovel, 2016; and Africa Capacity Building Foundation, 2016). Thus, there is need to complement this with the alternative such as external financing.

Also, regardless of the advantages of external sources, this must be properly considered in order not to subject the region to imperialism. This is supported by the controversy results from the literature surrounding the effect of external financing (most especially ODA and FDI) on health sector of developing countries. One body of evidence claims that these improve health outcomes, bolstering the case for external financing's efficacy in encouraging development in the receiving country (Chauvet, Gubertet, & Mesplé-Somps, 2008; Ebeke & Drabo, 2011; Mallaye & Yogo, 2012), while the opposing viewpoint claimed that these are ineffective in improving health sector in underdeveloped countries (Gebhardtet al., 2008; Williamson, 2008; Wilson, Gebhard, Kitterman, Mitchell & Nielson, 2009). Despite the important of these studies in forming policy frameworks in developing countries, much remains unknown regarding effectiveness of external financing in improving health sector in SSA countries.

In addition, despite the large number of studies on the subject matter, none of the previous studies have considered the combined effects of external financing factors (FDI, PPI and ODA) on health infrastructure. More so, very little of the previous studies paid attention to the effect of external financing on health infrastructure. These are the gaps the present study is intending to address. The rest of the study includes sections on the review of relevant literature, methodology, discussion of the results, conclusion and policy recommendations.

2.0 Review of Relevant Literature

2.1 Conceptual Review

Health is more than just the absence of disease or weakness. It is a state of total physical, mental, and social well-being. Both national and international authorities have been concerned about improving public health. The growing focus on public health outcomes stems

from a knowledge that“wealthier nations are healthier nations” and “gains from rapid economic growth flow into health gains” (Pritchett & Summers, 1996). One of the key efforts toward developing the country's health sector is health infrastructure. The term 'infrastructure' is simply regarded as the core physical structure consisting of transportation, water supply, telecommunication, power infrastructure among others which are otherwise known as capital (Oscar, 1988; Canning, 1998). Thus, health infrastructure are those facilitates that have both direct and indirect impact on the welfare of the people, that is, the infrastructure that promotes the health sector (Snieska & Simkunaite, 2009).

Basically, the major sources of financing health infrastructure include both the domestic and external sources. The domestic sources can simply be regarded as the funds available within a country that can help boost economic activity or, at the very least, have the potential to help the country flourish, if properly handled. Government capital expenditure, commercial banks, private capital, pension funds, and the domestic capital market are just a few examples. On the other hand, external source of funding health infrastructure involves varietyof foreign sources of funds that promote or at least have the potential to promote development in the destination countries if they are well managed(Odedokun, 2004). Official bilateral and multilateral flows, private commercial and non-commercial flows, and non-government organizations are only a few examples.

2.2 Theoretical Review

The issue on effectiveness of external financing on the growth and development of developing countries can be traced back to the popular two-gap model of development which was designed by Harrod and Domar(1947) and later developed by Chenery (1966). The theory identifiesthe relations between the 'savings constraint' and the 'foreign exchange constraint' in determining a developing country's growth rate. The model tried to analyze the prerequisites for market economy growth.These two preconditions are primarily found in emerging countries, and one of them is the internal precondition, in which insufficient savings would inevitably lead to poor investment, and the gap between the two is referred to as saving constraints.The second, or external pre-condition, is a lack of foreign exchange as a result of an inability to export in comparison to excessive imports, resulting in a foreign exchange shortage. The relevancy of this theory is that it remains a crucial theoretical framework in the literature on effectiveness of external financing.

However, as previously stated, there is still no sufficient consensus on the usefulness of external financing (such as FDI and ODA) in terms of health infrastructure or economic development.Two opposing explanations have evolved in the last two decades, with thefirst one being the public interest hypothesis while the second one is the public choice hypothesis(Sachs, 2005; Williamson, 2008). The public interest hypothesis state that aid should be used to help in the development process, while the second hypothesis is of the view that aid may be counterproductive to human development and may have a negative impact on emerging countries' future growth prospects and competitiveness(Easterly, 2001; Rajan & Subramanian, 2005).

2.3 Empirical Review

Taking into account a number of studies on the effectiveness of various external financing

factors, the findings of these studies revealed that they are of a mixed nature. Also, majority of the empirical research on infrastructure focus on analyzing the benefits of infrastructure to growth and development. Although there are some studies on infrastructure financing as well as health outcomes, but there are less literature on health infrastructure, or the determinants of health infrastructure. For instance, empirical studies have shown that economic growth and development in developed countries are aided by the development of infrastructural facilities such as roads, energy, water, and sanitation (Canning & Pedroni, 1999; Rashidi & Samimi, 2012).

Among the recent studies that have investigated the impact FDI (as one of the factors of external financing) on health outcomes is Herzer and Nunnenkamp (2012), where they examine the long-run effect of FDI on health in 14 developed countries using dynamic ordinary least square estimator, with data set between 1970 and 2009. The findings from the study reveal a statistically significant and negative relationship between foreign direct investment and health (life expectancy).Similarly, the impact of FDI on population health is investigated byHerzer, Nagel and Nunnenkamp (2015)for 179 countries from 1980 to 2011. The study employed panel fixed-effects estimates for the analysis of the model. The results of the study reveal that the relationship between FDI and health is non-linear and varies by income level.

In addition, Okafor and Ihayere (2019) examine the nexus between FDI and health using MMR as a proxy for health outcomes in Nigeria for the period of 1980 to 2016. The study employed VAR/VECM technique to address the problem of endogeneity. Findings from the study show that FDI has a significant impact on health outcomes in Nigeria. Also, Salahuddin, Vink, Ralph and Gow (2020) examine the effects of FDI and economic growth on child health outcomes (infant mortality rate and Under 5 mortality rate) in South Africa for the period of 1985 to 2016 by employing ARDL. Apart from FDI, the study also considers other control variables such as corruption, inequality, HIV among others. The results of the study show that FDI and economic growth have negative significant effects on the indicators of child health outcomes in both the short run and the long run. This implies that both FDI and economic growth help to reduce child mortality rate and hence enhance child health outcomes in South Africa.

Apart from FDI, effect of foreign aid on health outcomes has also been largely investigated by various studies, even though the empirical results of some of the studies revealed that foreign aid has no significant impact on health outcomes (Burnside & Dollar, 2000;Masud & Yontcheva, 2005; Williamson, 2008; Moyo, 2009; Nunnenkamp & Öhler, 2010; Irfan & Nehra, 2016; Nwude, Ugwoke, Uruakpa, Ugwuegbe & Nwonye, 2020). On the other hand, the conclusions of some other studiesare in contrary to the above, where they found that foreign aid has significant impact on health outcomes (Levine & Roodman, 2004; Fielding, Mcgilivry & Torres, 2006;Gebhard et al., 2008; Wilson, 2011; and Yousuf, 2012).

Studies on the determinants of infrastructure have also identified GDP, capital expenditure, population, urbanization among others. While many of these studies focused on infrastructure spending (Arimah, 2005; Kirkpatrick et al.,2006; Araya et al.,2013; Mizutani & Tanaka, 2008; Mohanty, 2017), others focused more on a single infrastructure indicator (viz: energy, telecommunications, transports, water, health, among others) or physical component of infrastructure (De, 2010; Akanbi, 2013; Onikosi-Aliyu, 2014; and Noah, 2021).

Despite the vast empirical literature considering the effect of foreign aid and FDI on health sector, there are very little or no empirical evidence on the effects of external financing factors on health infrastructure. Apart from FDI and ODA which were largely considered as external financing factors in most of the previous studies, private participation in infrastructure has largely been neglected as an external financing factor of financing health infrastructure. In addition, the conclusion on the effectiveness of external financing on health is still in doubt because of the mix results which need further verification. These are the gaps that the present study addresses by investigating the combined effects of external financing factors on health infrastructure as well as other control variables.

3.0 Methodology

As stated earlier, the Two-Gap Model is adopted as a theoretical foundation for the present study which identifies the pre-conditions for economic growth of market economies.

The study formulates the models based on the theoretical and empirical literature discussed in the earlier by adapting the model used by Williamson (2008) and De (2010). Thus, the model for the external financing and health infrastructure can be stated as follows:

$$H_{it} = \gamma_0 + \gamma_1 GDPC_{it} + \gamma_2 GCE_{it} + \gamma_3 INS_{it} + \gamma_4 DFD_{it} + \gamma_5 POP_{it} + \gamma_6 URB_{it} + \gamma_7 PPI_{it} + \gamma_8 FDI_{it} + \gamma_9 ODA_{it} + \varepsilon_{it} \quad \ldots\ldots 3.1$$

Where *H* is the health infrastructure (proxied by the number of hospital beds per 100,000 people), *GDPC* is the per capita gross domestic product,*GCE is tota*l government capital expenditure (as a ratio of GDP),*INS is the institutional quality (proxied by g*overnance index), *DFD* is the domestic financial development (as a ratio of GDP), *POP* is the population density, *URB* is urbanization (% of total population), *ODA* is official development assistance (ratio of GDP), *PPI* is private participation in infrastructure (ratio of GDP) and *FDI* is foreign direct investment (ratio of GDP), γ_1 - γ_9 are the coefficients of explanatory variables, γ_0 is intercept term, ε is error term, *t* is time and *i* iscountry. Based on the theoretical and empirical justifications of the variables above, the *a priori* expectations of the signs of the parameters of the model are written in inequality notations as: $\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5, \gamma_6, \gamma_7, \gamma_8 and \gamma_9 > 0.$

3.1 Methods of Analysis

The methods of analysis employed by the present study include descriptive analysis, simple correlation analysis and panel data regression analysis. The descriptive statistics of the data are used to have a good understanding, description and summary of the data in a meaningful way. This will be carried out using relevant summary statistics such as mean, standard deviation, minimum, and maximum values. Examining the correlation coefficient for each pair of the variable considered in the model is the simplest, easiest and preliminary way to detect the degree of multicollinearity. The panel data regression analysis entails the use of panel multiple regression analysis to determine the effectiveness of external financing and other control variables (the explanatory variables) on health infrastructure.

The method of estimating equation is the panel estimation technique which includes pooled OLS, fixed effect and random effect (depending on the results of pre and post-estimation). If the

pooling assumption is correct, then the pooled OLS method of estimation can be adopted and, if otherwise, the fixed or random effect method can be adopted, depending on the behaviour or feature of the error terms (Asterious & Hall, 2011).

3.2 Nature, Coverage and Sources of the Data

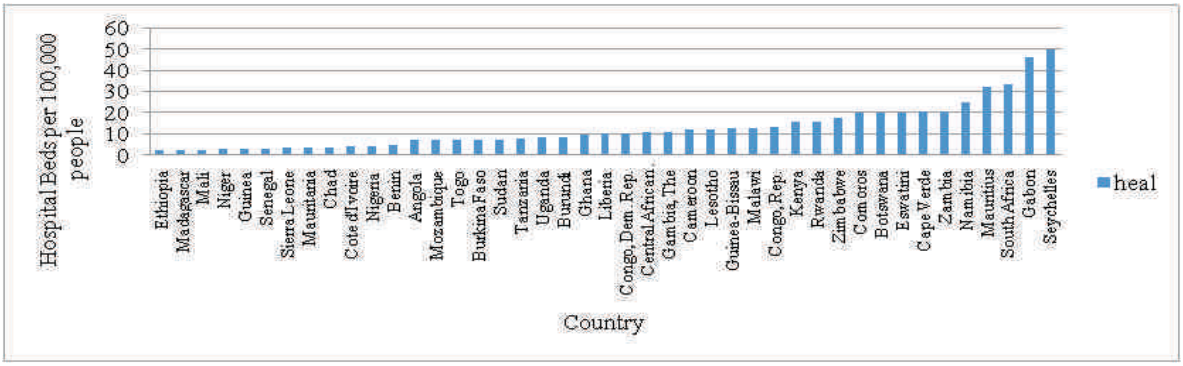
The data collected for this study are annual data across forty three countries in SSA, from various secondary sources for the period 2000 to 2018. The list of the countries and the period covered were both dictated by data availability most especially for the variable of interest-external financing (PPI, FDI and ODA). The data for this study were sourced from various secondary sources which include World Bank's World Development Indicators, WDI (2020),International Monetary Fund's *International Financial Statistics (2020) and* World Health Organization (2020).

1.0 Results and Discussion

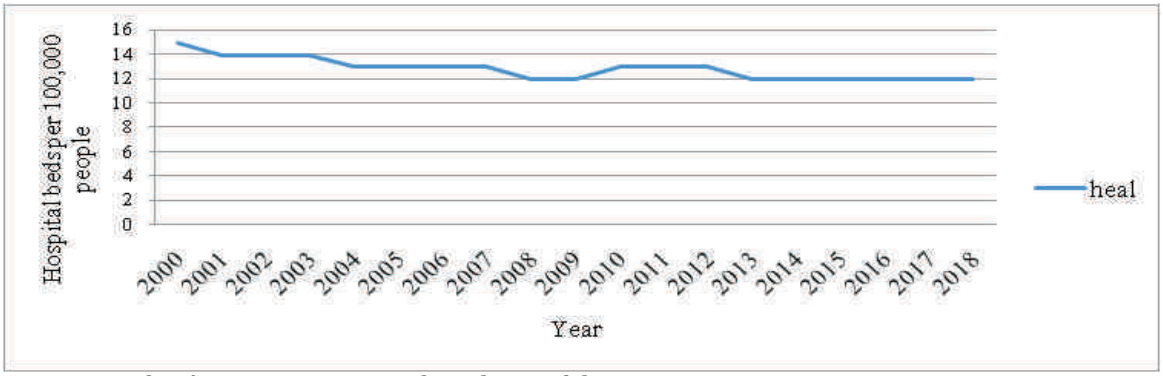
Graphical analysis of health infrastructure is presented in Figure 4.1. The bar diagram shows the average of access to health facility in each SSA country, while line chart shows the trendo f cross-country average of access to health facility from year 2000 to 2018 for the SSA regionThe bar diagram in Figure 4.1 shows that the top ten countries with highest access to health infrastructure include Seychelles, Gabon, South Africa, Mauritius, Namibia, Zambia, Cape Verde, Botswana, Comoros and Eswatini, while the last ten countries with the lowest access to health infrastructure in ascending order include Ethiopia, Congo DR, Madagascar, Angola, Mozambique, Chad, Niger, Tanzania, Sierra Leone and Mauritania.

The line chart shows that the average number of hospital beds per 100,000 people in SSA decline steadily. This implies a declined in access to health infrastructure throughout the period of study.

Table 4.1 presents the summary statistics of the panel series for this study. The values of the mean, maximum, minimum, standard deviation, skewness and kurtosis are presented in columns three to eight respectively. The value of health infrastructure, per capita gross domestic product (GDPC), total government capital expenditure (GCE), domestic financial development (DFD), institutional quality (INS), population density (POP), urbanization (URB), private participation in infrastructure (PPI), foreign direct investment (FDI) and official development assistance (ODA) are presented from the rows2 to 11 respectively..



Source: Author's computation and analysis of data, 2021



Source: Author's computation and analysis of data, 2021

Figure 4.1: Distribution of SSA Countries according to the Average Access to Health Infrastructure and the Aggregate Trend in Access to Health in the Region in 2000 - 2018

Table 4.1: The Descriptive Statistics

	Variables	Mean	Maximum	Minimum	Standard Deviation	Skewness	Kurtosis
1	H	12.871	93	0.005	12.161	2.523	12.225
2	GDPC	4076.643	27114.02	545.296	4763.569	2.246	7.726
3	GCE	53.567	840	0.001	91.413	4.171	26.778
4	DFD	30.414	151	0.687	20.576	2.047	7.710
5	INS	-1.484	250.716	-4.701	1.461	0.410	2.648
6	POP	98.157	623.302	2.180	123.795	2.388	8.998
7	URB	38.332	89.37	8.246	15.817	0.511	3.202
8	PPI	0.431	7.956	0.001	0.844	13.790	27.841
9	FDI	4.608	103.337	-6.057	8.481	6.128	54.090
10	ODA	8.738	92.141	-0.251	8.864	3.227	23.261

Source: Author's computation and analysis of data, 2021

Table 4.2 shows the coefficients of correlation between every pair of the variables (H, GDPC, GCE, DFD, INS, POP, URB, PPI, FDI and ODA) with their respective p-values below each of the correlation coefficients. The p-values show the significance of the correlation coefficients.A correlation coefficient is deemed to be statistically significant in the study if its p-value does not exceed 5%.

Based on all the above discussion, the results from the correlation analysis reveal that most of

Table 4.2: The Correlation Matrix

Variable	H	GDPC	GCE	DFD	INS	POP	URB	PPI	FDI	ODA
H	1.000									
GDPC	0.726 (0.000)	1.000 -								
GCE	-0.069 (0.050)	0.096 (0.006)	1.000 -							
DFD	0.385 (0.000)	0.323 (0.000)	0.061 (0.083)	1.000 -						
INS	0.404 (0.000)	0.551 (0.000)	-0.106 (0.002)	0.358 (0.000)	1.000 -					
POP	0.209 (0.000)	0.186 (0.000)	-0.062 (0.080)	0.128 (0.000)	0.203 (0.000)	1.000 -				
URB	0.400 (0.000)	0.575 (0.000)	0.230 (0.000)	0.258 (0.000)	0.243 (0.000)	-0.226 (0.000)	1.000 -			
PPI	0.121 (0.000)	0.108 (0.002)	0.441 (0.000)	0.168 (0.000)	0.020 (0.566)	-0.051 (0.142)	0.274 (0.000)	1.000 -		
FDI	-0.240 (0.994)	-0.435 (0.383)	-0.268 (0.549)	-0.011 (0.055)	-0.176 (0.720)	0.019 (0.002)	-0.311 (0.000)	-0.153 (0.137)	1.000 -	
ODA	-0.001 (0.000)	0.021 (0.000)	-0.021 (0.000)	0.067 (0.744)	0.013 (0.000)	-0.111 (0.585)	0.132 (0.000)	-0.052 (0.000)	0.217 (0.000)	1.000 -

Source: Author's computation and analysis of data, 2021

the variables are not correlated since none of the correlation coefficient of the regressors is as high as 0.8. This shows that there is likelihood of an absence of severe multicollinearity in the model (Asteriou & Hall, 2011) and, hence, the model estimated with the variables included in this study are free from severe multicollinearity.

In accordance with the objectives, this study estimate the impact of external financing on health infrastructure. After exploring the various pre-estimation and diagnostic tests, it was discovered that the FEM that was used for estimation was invalid for the analysis of the study due to some econometric problems. This was later corrected by adopting the Panel-Corrected Standard Error (PCSE) method which was the one eventually used for the analysis. Accordingly, the PCSE estimates are derived and reported in Table 4.3.

Table 4.3: PCSE Result Estimates for Health Infrastructure Equation

Variables (H: Dependent Variable)	Coefficients	t-value	p-value
GDPC	0.002	8.90	0.000
GCE	-0.019	-7.81	0.000
DFD	0.046	9.43	0.000
INS	1.159	6.30	0.003
POP	0.003	2.26	0.024
URB	0.013	0.37	0.710
PPI	6.078	2.72	0.007
FDI	-0.075	-2.41	0.016
ODA	4.458	4.96	0.000
R-square	0.638	-	-
Wald X^2stat.	1151.95	-	0.000

Source: Author's computation and analysis of data, 2021

The Table 4.3 results clearly show that the coefficients of GDPC, DFD, INS, POP, PPI and ODA are positive and statistically significant, GCE and FDI are negative and statistically significant while only URB is statistically insignificant. This means that GDPC, DFD, INS, POP, PPI and ODA all have positive effects on health infrastructure, while GCE and FDI have negative effects on health infrastructure but URB has no effect on health infrastructure. The implication of this is that a one dollar increase in GDPPC causes the health infrastructure to increase by 0.002 unit,a one unit increase in DFD, PPI and ODA causes the health infrastructure to increase by 0.046, 6.078 and 4.458 units respectively. Also, a one index increase in INS causing the health infrastructure to increase by 1.159 units, and an increase in the population per land area (km^2)will leads to the increase in health infrastructure by 0.003 unit. In addition, aone unit increase in GCE and FDI will cause the health infrastructure to decrease by 0.019 and 0.075 units respectively. The observed positive effects of GDPC, DFD, INS, POP, PPI and ODA are in conformity with the *a priori* expectations and are also in line with the empirical findings from the previous studies, including those reported by Fielding, Mcgilivry and Torres (2006), Gebhard *et al.,* (2008), De (2010), Wilson (2011), Akanbi (2013), and Yousuf (2012) among others, while the negative effects of GCE and FDI on health infrastructure are also supported by the empirical findings from the studies reported by Onikosi-Aliyu (2014), Irfan and Nehra (2016), and Nwude *et al., (2020).*

The study also consider the robustness tests for the validity of the model which show that the reported R-squarevalue of the model 63.8 percent, indicating that the explanatory variables are able to explain the same percentage variations in health infrastructure. Also, the Wald Chi-square-statistics values of 1151.95 (with the p-value of 0.000) show that the model has high explanatory power and that they all fit the data properly since the p-value of the corresponding value of Wald Chi-square-statistics is less than 10 percent in the model, this study therefore rejects the null hypothesis that the overall model is not statistically significant.

5. Conclusion and Recommendations

Infrastructure is essential to basic functioning of modern society, and without the critical infrastructure services such as high quality health care facilities, education, transportation

systems, high-speed telecommunications services and proper sanitation facilities, human activities would have been more difficult.The development of a country's health sector necessitates efforts in a variety of areas, including health infrastructure, health service funding, and the formation of a health guarantee system, health delivery systems, and health workforce enhancement. Healthcare systems in both the developed and developing worlds have been put under unprecedented strain as a result of the COVID-19 pandemic, with demand outstripping supply. Since the outbreak of Coronavirus, specifically during the global lockdown, most countries of the world banned or limited the export of medical facilities.

However, most SSA countries lack the resources and capability to provide the necessary health facilities needed to enhance the population health and the entire health system, thus, there is need to complement this with the alternative such as external financing, even though there are controversy results from the literature surrounding the effect of external financing on health sector. Because of this, there is the need to examine the basic factors that drive health infrastructure. In this regard,this study examines the effectiveness of external financing and other postulated determinants on health infrastructure in SSA for the period of 2000 to 2018 by employing Panel-Corrected Standard Error (PCSE) for the analysis of the model.

It concludes from the findings and subsequent discussion in this study that, external financing factors as a whole, has positive effects on health infrastructure. Specifically, both private participation in infrastructure and official development assistance have positive effects on health infrastructure, while foreign direct investment has negative effects on health infrastructure. It can also be concluded that all other control variables (per capita GDP, total government capital expenditure, domestic financial development, institutional quality, population density) have significant impact on health infrastructure except urbanization.

Based on the findings and conclusions from this study, it recommends that **SSA countries** should make sure necessary policies are put in place to improve their per capita GDP, domestic financial development, institutional quality and population density for the purpose of promoting health infrastructure. Also, since the findings from the present study have shown that both private participation in infrastructure and official development assistance influence health infrastructure, it therefore recommends that, theseshould be encouraged for promoting health infrastructure and, there is need to promote private participation in infrastructureand ODA funds from multilateral and bilateral sources could be geared towards development of health infrastructure, among others.

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