On the efficiency of public health expenditure in Sub-Saharan Africa: Does corruption and quality of public institutions matter?

Novignon, Jacob

Economics Department, University of Ibadan

4 February 2015

On the efficiency of public health expenditure in Sub-Saharan Africa: Does corruption and quality of public institutions matter?

Jacob Novignon[1]

Abstract

Health expenditure in Sub-Saharan Africa (SSA) has improved over the years with several recent efforts to improve resource commitments to the health sector. Health outcomes in the region have, however, seen little improvements over the years. Several reasons, including the efficiency of health expenditure, have been given to justify this mismatch. Studies on health expenditure efficiency have mainly focused on developed regions with little attention to SSA. The objective of the study was, therefore, to examine The effects of corruption and public institution quality on efficiency. The efficiency of health expenditure was also compared across selected SSA countries. Data for the study was sourced from the World Bank's *World Development Indicators* for 45 countries covering the period 2005 to 2011. The two-stage Data Envelopment Analysis (DEA) was employed for the analysis. The first stage computes efficiency scores while the second stage examines the determinants of efficiency using the Tobit model. Per capita health expenditure was used as input while infant, under-five mortality and crude death rates were used as outputs. The results show that health expenditure efficiency was low with average scores of approximately 0.5. This suggests that there exist significant potential for SSA countries to improve population health outcomes given the level of expenditure. There was significant variation across countries with Cape Verde, Eritrea and Mauritius among the efficient countries while Equatorial Guinea, Sierra Leone and Swaziland were relatively inefficient. High corruption and poor public sector institutions reduced health expenditure efficiency. The findings emphasize the fact that, while increased health spending is necessary, it is also important to ensure efficiency in resource use across SSA countries. This can be achieved by effective monitoring and evaluation programmes that ensure reduced corruption and improved public institutions.

Keywords: Health expenditure efficiency, Tobit model, DEA, SSA, Corruption, Public institutions
JEL classification: C50, C67, I10, I12

[1] Ph.D candidate at Department of Economics, University of Ibadan, Ibadan-Nigeria.
Email: nonjake@gmail.com

1.1 Introduction

Sub-Saharan African countries have been identified to be less efficient in the use of health resources. The World Health Report of 2000 showed that countries in developing regions (like SSA) possess significant potential to improve health status if resources are used in an efficient way. With SSA facing high disease burdens and poor performance in terms of health status, the potential benefits of an efficient health system cannot be over emphasised.

The Africa region lags behind in achieving the health-related MDG targets with most countries in the region unlikely to achieve these targets. HIV/AIDS, malaria and tuberculosis remain the major causes of mortality and morbidity in the region with estimated incidence of 217; 21,537 and 276; per 100,000 population, respectively in 2009 (WHO, 2012). The WHO in 2011 also showed that only eight countries were on track to achieve the health related MDGs. Majority of the countries in the region were achieving less than 50% of what is expected to reach the target in 2015, with progress on MDG 5 (maternal mortality) being particularly slow.

Adequate and sustained levels of health resources is often identified as the biggest constraint to achieving improved health outcomes and economic growth in general (Tandon and Cashin, 2010). The Abuja declaration of 2001 was intended to improve health expenditure in public budgets in SSA with the aim of improving health. However very few countries in the region are close to the target of 15% of government budget (Tandon and Cashin, 2010).

Improving this situation requires a comprehensive analysis of health systems in the region with regards to the efficiency in the use of resources (Powell-Jackson *et al.*, 2012). For instance the WHO (2012) noted that high or low levels of health funding might not translate into improved health outcomes but rather efficiency and equity in the use of these resources. The purpose of this study, therefore, was to evaluate the efficiency of health expenditure as well as the effects of corruption and public institutions on health expenditure efficiency.

2.1 Overview of Health systems in SSA

Before the global economic meltdown in 2007/2008, efforts towards the improvement of health in SSA received much attention from the international community with funding to combat health problems which kept rising steadily. Evidence of improved health was recorded in some

countries like Uganda and Tanzania (Bryan *et al.*, 2010). In spite of this progress, many other countries in the region have struggled to show improvement in health status with diseases such as Malaria, HIV/AIDS and Tuberculosis still having devastating effects on the population in SSA. This has led to a call to improve the health systems in SSA countries by ensuring efficiency in public health expenditure.

The world economic outlook report argues that majority of the health problems facing SSA could be avoided with a well functioning, efficient and effective health care system (Neelam, 2007). Indeed, questions about who pays for health, how much do they pay, where is money spent, who delivers health services and how good are services delivered, characterize the performance of the health system in SSA. While there has been recent calls to increase resources devoted to the health sector, the efficiency in using the existing resources have been over-looked. The relatively low levels of health expenditure underscores the need for understanding health expenditure efficiency in the region

The pattern and trend in the performance of health care expenditure across regions of the world and the world average show that, relative to all other regions of the world (with the exception of MENA), SSA spends the lowest on health as percentage of Gross Domestic Product (GDP). Total health expenditure as percent of GDP increased in SSA from 5.9 in 2000 to 6.4 in 2011, relative to the world average of 9.2 to 10.1, North America (from 13.1 to 17.1), OECD (from 10.0 to 12.3), MENA (from 4.6 to 4.8) and EAP (from 6.6 to 6.8).

Further, public health expenditure as percent of GDP in 2011 was 2.9% for SSA relative to the world average (6.0%), North America (8.2%), East Asia and Pacific (4.6%). Similarly, private health expenditure as percentage of GDP was 3.6% for SSA, which suggests poor performance against the world average (4.1%), East Asia and Pacific (2.2%) and North America (9.0%) in 2011. This suggests that health related expenditures still remain major concerns in developing regions like SSA (Table 2.1). It is worth noting that, relative to other regions of the world, only SSA and North America has private health expenditure as percentage of GDP higher than public health expenditure. All other regions have greater share of their public health expenditure sources relative to private sources.

Moreover, SSA remains one of the most burdened regions in terms of communicable and non-communicable diseases and health in general. This explains the significantly high maternal and child mortality rates as well as crude death rates in the region, relative to all other regions in the world. It is reported that communicable diseases alone accounted for about 798 age-standardized deaths per 100,000 population in 2008. Similarly, non-communicable diseases accounted for 779 deaths per 100,000 population. These statistics are above the global average 230 and 573 deaths per 100, 000 population caused by communicable and non-communicable diseases respectively (WHO, 2013).

Mortality among children in the region are mainly caused by Diarrhoea (11% in 2010), Malaria (15% in 2010) and Pneumonia (17% in 2010). In the case of adults, the highest ranked causes of death in the SSA region include HIV/AIDS (139 deaths per 100,000 population 2011), malaria (72 deaths per 100,000 population in 2010) and tuberculosis (26 deaths per 100,000 population in 2011). These statistics are higher than the world average and any other region of the world (WHO, 2013).

In addition to the high disease burden in the SSA region, the region also lacks health workforce and infrastructure necessary to improve the health status of the population. The region is faced with the problem of "brain drain", where trained health workforce leave for greener countries in other developed regions of the world. Between 2005 and 2012, an average of 2.5 physicians and 9.1 nurses/midwifery personnel per 10,000 population were recorded in the SSA region. These statistics significantly fall short of the world average of 13.9 physicians and 29.0 nurses/midwifery personnel per 10,000 population.

3.0 Theoretical Literature

3.1 Health Production Function

The first attempt to conceptualize health capital and investment is credited to Grossman (1972). The theoretical formulation of Grossman provides a micro-level insight into the investment made by individuals to improve their stock of health as it depreciates over time. It is worth noting that earlier studies provided theoretical insight into investment in human capital in general. For instance Becker (1967) and Ben-Porath (1967) developed models that determine the optimal quantity of investment in human capital. Other studies have considered health as any other form

of human capital and argued that the model on investment in human capital could also be applied to health capital (Mushkin, 1962, Becker, 1964, Fuchs, 1966).

Grossman (1972) provided a contrary argument that health capital is unique and should be distinguished from any other form of human capital. The main point of departure from previous theoretical attempts on human capital is that while other forms of human capital[2] directly affects market and non-market productivity, health capital influences the total amount of time available to engage in these market and non-market activities. For instance, one's knowledge of an economic activity will influence how much of output from that activity can be produced. However, the individual's health status determines how much time the individual can spend producing. This implies that even though the individual has the knowledge to produce more, this may be limited by the poor health of the individual.

The relevance of the Grossman model in the current study lies in the proposition that individuals inherit an initial stock of health that depreciates over time but can be increased by investments in health. Gross investments in health capital are produced by production functions whose direct inputs include the time of the individual and other market goods such as medical care, diet, exercise, recreation and housing. The amount spent on these market goods directed to improve the stock of health may be considered as health care expenditure. Aside the consumer's time and market goods, other environmental factors may influence the production function. The education of the producer is considered to be the most important environmental variable and also relevant to the efficiency of the production process.

If the production of health is considered as a shared responsibility between individuals and government, then the model by Grossman can be extended to the macro level by considering the entire health system as a production process where inputs are converted into outputs. In this case the outputs are the population health status which represents the end result of an efficient use of health inputs. Like the micro level, health inputs at the macro level include the use of various market goods such as provision of hospitals and equipments needed in the hospital, improved sanitation and water supply, improved working conditions, mass media communications on

[2] The stock of knowledge is considered as an example of the forms of human capital

health and various forms of preventive and curative interventions. While these market goods may be difficult to identify the level of expenditure can be used to capture health inputs into the health system at any point in time.

In a similar theoretical presentation Wagstaff (1986) used the concept of health production function to express the notion that individuals can control their health through their influence on health affecting consumption patterns, their health care utilization and their environment. At the macro level, this can be conceptualized as the government influencing the health of the population through investments in these variables. Wagstaff (1986) argues that just like the case in any firm where production functions are seen as a process where outputs are produced by combining factor inputs, individuals also produce health by combining health inputs. Similarly at the macro level, population health can be improved by effective and efficient combination of health inputs. The production process therefore simply links health inputs to the output, health.

3.3 Empirical Evidence

Empirical evidence on efficiency in the health economics literature have, over the years, concentrated on various components of the health system. These studies are micro based and mostly answer the question of how health inputs are used to generate the highest possible outcomes within specific components of the health system. In SSA, most of these micro-based studies have been at the hospital level (Kirigia *et al.*, 2010, Tlotlego *et al.*, 2010). In a typical setting, such studies that estimate efficiency at the hospital level use hospital workforce (including physicians and nurses population) and hospital beds as inputs and inpatient and outpatient days as health outcomes.

Another set of studies have analysed efficiency at the disease level. The import of such studies is basically to estimate the efficiency in the use of health resources in the prevention and treatment of diseases. Such empirical analysis have been done within and across countries (Baily *et al.*, 1997, Garber and Skinner, 2008). Inputs used in such studies include among others labour (physicians, nurses and technicians), supplies (medications, surgical instruments and X-ray films) and capital (diagnostic equipments and hospital facilities). Survival rates or quality of life with respect to each disease treatment may be used as outcome variables.

In much more recent years, the attention of empirical studies on efficiency in the health economics literature have been on the health system as a whole. This type of macro level analysis of how health resources are used to generate population health outcomes is fast gaining grounds. Unlike the micro based studies on efficiency, health care expenditure per capita has been widely used as the input variable (WHO, 2000, Afonso and Aubyn, 2005). A few studies have, however, exclusively used physical inputs (including population of physicians, nurses and hospital beds) at the macro level (Bhat, 2005). Life expectancy, infant, under five and maternal mortality rates as well as child survival rates and disability adjusted life years (DALY) have been widely used as measures of health system output.

The pioneering attempt to estimate cross country health expenditure efficiency is credited to the World Health Report published in the year 2000. The report provided estimates of health system performance for 191 member states of the WHO. Following this, several other studies have emerged using various methods and data to estimate the efficiency of health expenditure across countries. Majority of the studies focused on OECD countries using the Data Envelopment Analysis (DEA) approach and showed evidence of some level of inefficiency in health expenditure with significant variations across countries (Hernandez de Cos and Moral-Benito, 2011, Kotzian, 2009, Bhat, 2005, Afonso and Aubyn, 2005)

A few other studies progressed to the second stage to identify factors that are responsible for health expenditure efficiency. The Tobit model was mostly used with variables within and out of the health sector being considered (Kotzian, 2009). Specifically, variables that have been found to be significant determinants of health expenditure efficiency include physician salary and reimbursement structure (Bhat, 2005); inadequate cost recovery, weaknesses in the financing mechanism, institutional arrangements and weaknesses in targeting public subsidies on health care (Jafarov and Gunnarsson, 2008); civil unrest and the prevalence of HIV and AIDS (Evans *et al.*, 2001, Herrera and Pang, 2005); health expenditure, nutrition and female education (Alexander *et al.*, 2003, Gupta and Verhoeven, 2001).

Majority of these studies have focused on developed countries, mainly OECD countries with very little attention on developing countries such as SSA. A critical contribution will be to fill

this gab and to identify policy variables that potentially pose significant challenges to health systems in the SSA region.

4.0 Methodology

4.1 Formulation of the DEA model

The study employed the two-stage DEA model to examine the effectiveness with which public health expenditure are used to generate population health outcomes across SSA countries. In the first stage, the extent to which a country could achieve better health for its population if all health expenditure were used efficiently was estimated and compared across. The Tobit model was used to examine the role of corruption and public sector institutions in influencing efficiency of health expenditure. The empirical methods employed in this study follow Fare et al. (1994) and Alexander et al. (2003) using non-parametric linear programming techniques.

The empirical analysis starts by finding out the achievable population health outcome of a particular country, given its expenditure on health. This optimization problem is solved by constructing a 'best practice' frontier, which is a piece-wise linear envelopment of the health expenditure-health outcome data for the sample countries. The estimated frontier describes the most efficient performance conditions within the countries and therefore forms a benchmark for comparison.

Efficiency in the production of population health is measured relative to such a frontier for each country. The health systems of countries that are operating on (and determine) the frontier are termed efficient while countries with health systems operating off the frontier are considered to be relatively inefficient. Inefficiency in this case should be understood to mean that better population health outcomes could be attained from the observed health expenditure, were performance similar to that of 'best-practice' countries (Alexander et al., 2003).

To better understand the procedures described above, let S^t be the technology that transforms health sector expenditure into population health outcomes. This technology can be modelled by the output possibility set

$$P^t(x^t) = \left\{ y^t : (x^t, y^t) \in S^t \right\} t = 1,...,T \qquad (1)$$

where $P^t(x^t)$ denotes the collection of population health output vectors that consume no more that the bundle of resources indicated by the resource vector x^t, during period *t*.

The best practice frontier can be empirically estimated as the upper bound of the output possibility set, $P^t(x^t)$. The output possibility set, $P^t(x^t)$, can be estimated empirically by assuming that the sample set is made up of observations on *j=1,...J* countries' health systems, each using *n=1,...N* resources, x_{jn}^t, during period *t*, to generate *m=1,...,M* population health outcomes, y_{jm}^t, in period *t*. Accordingly, $P^t(x^t)$ is estimated from the observed set of health expenditures, and population health outcomes for all the countries of the sample.

The empirical construction of the piece-wise linear envelopment of the input possibility set is given by

$$\begin{aligned} &P^t(x^t) = \{ y^t : x_n^t \le \sum_{j=1}^{J} z_j x_{jn}^t, n = 1,...,N \\ &\sum_{j=1}^{J} z_j y_{jm}^t \ge y_m^t, m = 1,...,M \\ &\sum_{j=1}^{J} z_j = 1 \\ &z_j \ge 0, j = 1,...,J \} \end{aligned} \tag{2}$$

where z_j is a variable indicating the weighting of each of the health systems.

The output-based efficiency score for each country's health system for period *t* can be derived as

$$F_o^t(x_j^t, y_i^t) = \max\{\theta \text{ such that } \theta y^t \in P^t(x^t)\} \text{ where } F_o^t(x_j^t, y_i^t) \ge 1. \tag{3}$$

This suggests that a county's health outcomes vector, y^t, will be located on the efficiency frontier when equation (3) has a value of one. However, if equation (3) produces a value less than one, the health system must be classified as inefficient relative to best-observed practice. This measure can be computed for country *j* as the solution to the linear programming problem

$$F_o^t(x_j^t, y_i^t) = \max \theta \tag{4}$$

with θ, z such that

$$\begin{aligned}
&\sum_{j=1}^{J} z_j y_{jm}^t \geq \theta y_{jm}^t, m = 1,...,M, \\
&\sum_{j=1}^{J} z_j x_{jn}^t \leq x_{jn}^t, n = 1,...,N, \\
&\sum_{j=1}^{J} z_j = 1, \\
&z_j \geq 0, j =,...,J,
\end{aligned} \tag{5}$$

where the restrictions on the weighting variables, z_j, imply a variable returns to scale assumption in regard to the underlying technology of health production.

4.2 Choice of inputs and outputs

Health expenditure per capita expressed in purchasing power parity terms was used input. Following theory and common practice in the literature, the current study employed education (measured by average years of schooling) as indirect health input variable which, even though, not directly controlled by the health system, is highly likely to influence health status (Caldwell and Caldwell, 1985).

Life expectancy at birth, infant and under-five mortality and crude death rates were used as health outputs. However, as noted by Afonso and Aubyn (2005), efficiency measurement techniques suggest that outputs are measured in such a way that "more is better". Therefore consistent with practice in the literature, various transformations were performed on the mortality variables so that they are measured in survival rates. For instance, infant mortality rate (IMR) is measured as [(number of children who died before 12 months)/(number of children born)] X 1000. This implies that an infant survival rate (ISR) can be computed as follows;

$$ISR = \frac{1000 - IMR}{IMR} \tag{6}$$

This shows the ratio of children that survived the first year to the number of children that died and this increases with better health status. Similar transformations were performed for the other mortality variables.

4.3 Determinants of health expenditure efficiency

A Tobit model was used to estimate the relationship between dependent variable y_i (efficiency scores) and a vector of explanatory variables x_i (McDonald, 2009). For the *ith* Decision Making Unit (DMU), the Tobit model can be defined as follows:

$$y_i^* = x_i\beta + \varepsilon_i \tag{7}$$

If $Y_i^* \leq 0$, $Y_i=0$; If $Y_i^* \geq 1$, $Y_i=1$ and if $0<Y_i^*<1$, $Y_i=Y_i^*$

Where y_i^* is an unobservable latent variable, ε_i is normally, identically and independently distributed with zero mean and variance, σ^2. x_i is a vector of explanatory variables and β, a vector of unknown coefficients.

The following reduced-form equations were specified for the purposes of estimation.

$$ineff_{it} = \alpha_i + \beta_1 Corrupt + \beta_2 PuHE_{it} + \beta_3 Y_{it} + \beta_4 \operatorname{Im} m_{it} + \beta_5 S_{it} + \beta_6 HIV_{it} + \beta_7 U_{it} + \sum_n \gamma_n Pop_{nit} + \varepsilon_{it} \tag{8}$$

$$ineff_{it} = \alpha_i + \beta_1 Inst + \beta_2 PuHE_{it} + \beta_3 Y_{it} + \beta_4 \operatorname{Im} m_{it} + \beta_5 S_{it} + \beta_6 HIV_{it} + \beta_7 U_{it} + \sum_n \gamma_n Pop_{nit} + \varepsilon_{it} \tag{9}$$

Where *i* and *t* represent country and time, respectively, while *n* represents different population brackets in terms of the explanatory variables. A detailed description of the variables are presented in Table 1 below.

Table 1: Variable description and data source

Variables	Description	Data source
Public health care expenditure (PuHE)	Level of public spending on health expressed as percent of GDP. Includes spending from government budgets, external borrowing, grants and social health insurance funds	WDI
Real GDP per capita (RGDPpc) (Y)	Real GDP per capita measured in constant 2005 international dollars	WDI
DPT Immunization	Percentage of children ages 12-23 months who received DPT immunization before 12 months	WDI

(Imm)		
Sanitation (S)	Percentage of population using an improved sanitation facility	WDI
HIV prevalence rate (HIV)	Estimated number of adults aged 15-49 years with HIV infection expressed as percent of total population in that age group	WDI
Urbanization (Urban) (U)	Percentage of population living in areas classified as urban according to the criteria used by each country.	WDI
Population aged 14 years and below (Pop1)	Population age group below or equal to 14 years expressed as percentage of total population	WDI
Population 15-64 years (Pop2)	Population age group between 15 and 64 years expressed as percentage of total population	WDI
Population 65 years and above (Pop3)	Population age group above 65 years expressed as percentage of total population	WDI
Corruption	Country policy and institutional Assessment (CPIA) of transparency, accountability and corruption in the public sector rating (1-low to 6=high)	WDI
Quality of public administration	CPIA quality of public administration rating (1=low to 6=high)	WDI

Source: Author's compilation

Data for the study was obtained from the World Bank world development indicators (WDI). The data covered the period 1995 to 2010 across 45 countries in SSA[3].

5.0 Results

5.1 Determinants of health expenditure efficiency performance

Table 2 presents Tobit model results on the effect of corruption on health expenditure efficiency performance. The CPIA transparency, accountability, and corruption in the public sector rating (1=low to 6=high) was employed as a measure of corruption. The higher the rating the better the

[3] The following countries were included in the study: Angola, Benin, Burkina Faso, Botswana, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo Demographic Republic, Congo, Cote d'Ivoire, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, South Africa, Sao Tome, Senegal, Seychelles, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, The Gambia, Togo, Uganda and Zambia.

level of corruption in a particular country. The performance of the models and their suitability were reflected in the likelihood ratio (LR) chi square test for joint significance of the independent variables. The results in Table 6 suggest that the independent variables together are significant determinants of the level of efficiency of health expenditure in SSA. This can be seen from the highly significant chi-square test statistic at 1% significance level.

The results show a negative relationship between improved corruption and inefficiency. This implies that corruption plays a critical role in determining health expenditure efficiency and countries with relatively improved corruption levels are likely to have better efficiency performance.

HIV/AIDS was another important determinant of health expenditure efficiency. A positive and significant relationship was established between the variable and inefficiency in both analysis. This implies that countries with relatively higher HIV/AIDS burden were more likely to perform poorly in terms of health expenditure efficiency. A similar relationship was established by Alexander et al. (2003) that the proportion of adults living with HIV/AIDS negatively associates with efficiency. This relationship may be explained by the fact that countries with high prevalence of HIV usually have higher pressure on health spending and also reduced health outcomes.

Table 2: Tobit model for improved corruption and health expenditure efficiency

Variable	**M(UI;2IN)**	**M(UC;2IN)**	**M(UIC;2IN)**
Corruption	-0.81109***	-0.26867**	-0.30241**
	(0.26131)	(0.11723)	(0.11320)
Immunization	0.00019	-0.00506	-0.00521
	(0.01219)	(0.00549)	(0.00529)
GDPpc	0.00009*	0.00001	0.00001
	(0.00005)	(0.00002)	(0.00002)
Urbanization	-0.42351	-0.04132	-0.03616
	(0.26281)	(0.12017)	(0.11573)
Population <14	-0.04607	-0.02729	-0.03443
	(0.09451)	(0.04233)	(0.04081)
Population >65	-0.70815*	-0.24275	-0.24049
	(0.38910)	(0.17745)	(0.17067)
HIV	0.04434	0.06344***	0.05873***

	(0.03274)	(0.01536)	(0.01476)
Constant	9.16591*	3.61591	4.00063*
	(5.21557)	(2.33066)	(2.24721)
LR Chi2	21.88***	24.25***	24.37***
Pseudo R2	0.1465	0.2657	0.2741
No. of Obs.	45	45	45

Source: Author's computation

Note: ***significant at 1%; **significant at 5%; *significant at 10%. Standard errors are reported in parenthesis. **M(UI;2IN)**: Efficiency scores from two outputs, under-five and infant survival rates; two inputs, HCEpc and average years of schooling. **M(UC;2IN):** Efficiency scores from two outputs, under-five and crude survival rates; two inputs, HCEpc and average years of schooling. **M(UIC;2IN)**: Efficiency scores from three outputs, under-five, infant and crude survival rates; two inputs, HCEpc and average years of schooling.

In Table 3, the relationship between health expenditure performance and public institutions was investigated using the Tobit model. The Country Policy and Institutional Assessment (CPIA) quality of public administration rating (1=low to 6=high) was used as a measure of public institutions quality. The higher the ranking, the better the quality of public administration. The results show that improved quality in public administration relates negatively with health expenditure inefficiency. This implies that the higher the quality of public sector administration, the better the performance of the health system in terms of health expenditure efficiency. This suggests that an important step in the bid to improve health expenditure efficiency will be to do that alongside improving the quality of public institutions.

Table 3: Tobit model for Public Institutions and Health Expenditure efficiency

Variable	**M(UI;2IN)**	**M(UC;2IN)**	**M(UIC;2IN)**
Public administration Quality	-2.52359***	-0.82903**	-0.88660**
	(0.89478)	(0.37955)	(0.37297)
Immunization	-0.02575*	-0.01265**	-0.01356**
	(0.01268)	(0.00541)	(0.00530)
GDPpc	0.00072***	0.00026***	0.00026***
	(0.00020)	(0.00009)	(0.00008)
Urbanization	-0.40428	-0.08808	-0.06154
	(0.27797)	(0.12072)	(0.11782)
Population <14	-0.24350**	-0.11260**	-0.11587**
	(0.10148)	(0.04575)	(0.04416)
Population >65	-2.23167***	-0.90765***	-0.85531***
	(0.61460)	(0.26088)	(0.25566)
HIV	0.04767	0.09906***	0.08587***
	(0.04183)	(0.02316)	(0.02129)

Public sector management	2.33220**	0.74094	0.76670*
	(1.03414)	(0.43564)	(0.42896)
Constant	21.45481***	9.09611***	9.15508***
	(5.93994)	(2.60369)	(2.53369)
LR Chi2	24.24***	31.44***	30.05***
Pseudo R2	0.1989	0.4195	0.4120
No. of Obs.	45	45	45

Source: Author's computation

Note: ***significant at 1%; **significant at 5%; *significant at 10%. Standard errors are reported in parenthesis. **M(UI;2IN)**: Efficiency scores from two outputs, under-five and infant survival rates; two inputs, HEpc and average years of schooling. **M(UC;2IN):** Efficiency scores from two outputs, under-five and crude survival rates; two inputs, HEpc and average years of schooling. **M(UIC;2IN):** Efficiency scores from three outputs, under-five, infant and crude survival rates; two inputs, HEpc and average years of schooling

Again, HIV/AIDS showed a highly significant and negative influence on efficiency. Immunization coverage was also found to have strong correlation with efficiency. The results show that countries with improved immunization coverage corresponds to better health expenditure efficiency performance. This result confirms the finding by Alexander et al. (2003) and emphasises the need for such public health programmes to be protected and improved.

5.2 Comparative analysis of health expenditure efficiency

Table 4 and 5 explores the efficiency performance of health systems in terms of their health indicators and health care spending. Countries that were estimated to be efficient were included in Table 4 for the analysis of best performing health systems. Considering that these countries' health systems have formed the benchmark for the assessment of others, it is prudent to investigate how their health outcomes and health expenditure compare to the regional average to understand the nature of efficiency.

The table shows that nature of health expenditure efficiency can be explained from two perspectives: one is the group of countries that have higher than average per capita health care expenditure but significantly lower than average health indicators. The second comprise a set of countries that have lower than average health care expenditure with corresponding better health outcomes. For instance, while health expenditure per capita in Mauritius and Seychelles were higher than the regional average, this corresponds to significantly improved health outcome indicators, compared to the regional averages. On the other hand, Eritrea, Ethiopia and

Madagascar are examples of countries with low health expenditure per capita, but health outcomes are relatively better than might be expected despite the scarcity of health resources. This explains the nature of health system efficiency in these countries.

Table 4: Health indicators and expenditure for the best performers

Country name	HCEpc	U5MR	IMR	LE	CDR
Cape Verde	171.69	21.30	18.20	73.92	5.37
Eritrea	16.99	67.80	46.30	61.42	7.52
Ethiopia	51.96	77.00	51.50	59.24	9.39
Madagascar	39.55	61.60	42.80	66.70	6.41
Mauritius	841.95	15.10	12.80	73.27	7.00
Seychelles	989.37	13.80	11.90	73.46	7.40
Regional mean	**225.39**	**97.35**	**63.17**	**56.38**	**11.57**

Source: Author's computation
Note: HCEpc= health care expenditure per capita (constant 2005 international dollar) U5MR= under-five mortality rate; IMR= infant mortality rate LE= life expectancy at birth; CDR= crude death rate

Table 5 presents comparative analysis for the worst performing countries in terms of health system efficiency. The pattern of health outcomes and expenditure in these countries provide a clearer understanding of the nature of efficiency. The estimated efficiency scores for these countries lie way below the regional average. Again two group of countries can be deduced from the table; one group have significantly higher health expenditure above the regional average but this does not correspond to improved health outcomes. The other group, even though have health expenditure below average, their health outcomes are poorer than might be expected.

Cameroon, Nigeria and Sierra Leone had health expenditure slightly lower than the regional average but the deviation of the health outcome indicators from the regional average is significantly large. Almost all the health outcome indicators for these countries were considerably poorer relative to the regional average. Swaziland and Equatorial Guinea with significantly higher health expenditure, relative to the regional average, performed poorly in all the health outcome indicators.

A clearer observation on the nature of health expenditure efficiency can be made by comparing the best and worst performers. For instance, Cape Verde and Sierra Leone spend similar amounts on health care per capita, however, health outcome indicators for the two countries are vastly

different. With health expenditure per capita of $172 in Cape Verde, under-five mortality and life expectancy stands at 21.3 per 1000 live births and 74 years, respectively. A sharp contrast is observed in Sierra Leone where health expenditure per capita of about $165 correspond to under-five mortality of 185 per 100 live births and life expectancy at birth of about 48 years. Similarly, health expenditure per capita in Equatorial Guinea is significantly higher than Mauritius and Seychelles, however, health outcome performance is significantly better in Mauritius and Seychelles than in Equatorial Guinea.

Table 5: Health indicators and expenditure for the worst performers

Country name	HCEpc	U5MR	IMR	LE	CDR	Eff. Score*
Cameroon	127.92	127.20	79.20	51.58	6.00	0.26
Nigeria	137.45	124.10	78.00	51.86	14.06	0.25
Swaziland	433.51	103.60	69.00	48.66	14.25	0.21
Equatorial Guinea	1642.71	118.10	79.60	51.14	14.37	0.18
Angola	214.58	157.60	96.40	51.06	14.03	0.17
Sierra Leone	165.24	185.30	119.20	47.78	15.34	0.15
Regional mean	**225.39**	**97.35**	**63.17**	**56.38**	**11.57**	**0.50**

Source: Author's computation
Note: HCEpc= health care expenditure per capita (constant 2005 international $) U5MR= under-five mortality rate; IMR= infant mortality rate LE= life expectancy at birth; CDR= crude death rate. *Efficiency scores were based on Two outputs, Under-five and Infant survival rates; Two inputs, HCEpc and years of schooling

6.1 Conclusion

The study explored health spending and outcomes in SSA, considering that the region faces high health challenges despite the numerous efforts to increase investments into the health systems. The objective of the study was to examine the efficiency of health expenditure as well as the effects of corruption and public sector institutions on the efficiency of health expenditure efficiency in SSA.

Evidence from the DEA model show significant variation in the efficiency of health expenditure across countries. This suggests significant potential for improvement in population health status given the current level of health resources invested into the health system. In a second stage analysis, the factors the explain the differences in the level of efficiency across countries were indentified. High corruption levels were identified as a critical limiting factor to health

expenditure efficiency in SSA. Also, countries with lower quality institutions were less efficient in using health expenditure.

It can be concluded that, the commitment of governments to the health sector has significant positive impact on health expenditure efficiency. Public sector challenges such as poor quality public institutions and corruption should be important policy focus if improved efficiency is to be achieved. Effective monitoring and evaluation programmes can be established to improve the performance of health expenditure in the region.

References

Afonso, A. and M. S. Aubyn (2005) 'Non-parametric approaches to education and health efficiency in OECD countries', *Journal of Applied Economics,* 8(2), 227-246.

Alexander, C. A., G. Busch and K. Stringer (2003) 'Implementing and interpreting a data envelopment analysis model to assess the efficiency of health systems in developing countries', *IMA Journal of Management Mathematics,* 14(1), 49-63.

Baily, M. N., A. M. Garber, E. R. Berndt and D. M. Cutler (1997) 'Health Care Productivity', *Brookings Papers on Economic Activity. Microeconomics,* 1997(ArticleType: research-article / Full publication date: 1997 / Copyright © 1997 Brookings Institution Press), 143-215.

Becker, G. (1964) *Human capital,* Chicago: The University of Chicago Press.

Becker, G. (1967) 'Human capital and the personal distribution of income: An analytical approach', *W.S. Woytinsky Lecture no.1. Ann Arbor: Univ. Michigan.*

Ben-Porath (1967) 'The production of human capital and the life cycle of earnings', *Journal of Political Economy,* 75, 353-367.

Bhat, V. N. (2005) 'Institutional Arrangements and Efficiency of Health Care Delivery Systems', *The European Journal of Health Economics,* 6(3), 215-221.

Bryan, L., M. Conway, T. Keesmaat, S. McKenna and B. Richardson (2010) *Strengthening sub-Saharan Africa's health systems: A practical approach*, New York: McKinsey and Company.

Caldwell, J. C. and P. Caldwell (1985) 'Education and literacy as factors in health' in Halstead, S. B., Walsh, J. A. and Warren, K. S., eds., *Goof health at low cost*, Ney York: The Rochefeller Foundation.

Evans, B. D., A. Tandon, L. J. C. Murray and A. J. Lauer (2001) 'Comparative efficiency of national health systems: cross national econometric analysis', *British Medical Journal,* 323, 307-310.

Färe, R., S. Grosskopf, M. Norris and Z. Zhang (1994) 'Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries', *The American Economic Review,* 84(1), 66-83.

Fuchs, V. R. (1966) 'The contribution of health services to the American economy', *Milbank Memorial Fund Q.,* 44, 65-102.

Garber, A. M. and J. Skinner (2008) 'Is American health care uniquely inefficient?', *Journal of Economic Perspectives,* 22(4), 27-50.

Grossman, M. (1972) 'On the concept of health capital and the demand for health', *The Journal of Political Economy,* 80(2), 223-255.

Gupta, S. and M. Verhoeven (2001) 'The efficiency of government expenditure: experiences from Africa', *Journal of Policy Modelling,* 23(4), 433-467.

Hernandez de Cos, P. and E. Moral-Benito (2011) 'Health ecpenditure in the OECD countries: efficiency and regulation', *Bank of Spain Occasional Documents No. 1107*.

Herrera, S. and G. Pang (2005) 'Efficiency of public spending in developing countries: an efficiency frontier approach', *World Bank Policy Research Working Paper 3645*.

Jafarov, E. and V. Gunnarsson (2008) 'Government spending on health care and education in croatia: Efficiency and reform operations', *International Monetary Fund Working Paper No. WP/08/136*.

Kirigia, J. M., O. A. Mensah, C. Mwikisa, E. Z. Asbu, A. Emrouznejad and P. Makoudode (2010) *Technical efficiency of zone hospitals in Benin*, Brazzaville: World Health Organization Africa Region.

Kotzian, P. (2009) 'Productive efficiency and heterogeneity of health care systems: Results of a measurement for OECD countries', *The Open Economics Journal,* 2, 20-30.

McDonald, J. (2009) 'Using least squares and tobit in second stage DEA efficiency analyses', *European Journal of Operational Research,* 197, 792-798.

Mushkin, S. J. (1962) 'Health as an Investment', *Journal of Political Economy,* 70(2), 129-157.

Neelam, S. (2007) *From funding to action: strengthening health care systems in sub-Saharan Africa*, Geneva: World Economic Forum.

Powell-Jackson, T., K. Hanson and D. Mclntyre (2012) 'Fiscal space fro health: a review of the literature', *Resilient and Responsive Health Systems Working Paper No.1*.

Tandon, A. and C. Cashin (2010) *Assessing public expenditure on health from a fiscal space perspective*, Washington, DC: The World Bank.

Tlotlego, N., J. Nonvignon, L. G. Sambo, E. Z. Asbu and J. M. Krigia (2010) 'Assessment of productivity of hospitals in Botswana: a DEA application', *International Archives of Medicine,* 3(27).

Wagstaff, A. (1986) 'The demand for health: theory and applications', *Journal of Epidemiology and Community Health,* 40, 1-11.

WHO (2000) *The world health report 2000. Health systems: improving performance*, Geneva: World Health Organization.

WHO (2012) *World health statistics 2012*, Geneva: World Health Organization.

WHO (2013) *World health statistics*, Geneva: World Health Organization.