

Assessing the Efficiency of Health-Care Expenditure Among Low- and Middle-Income African Countries: *Sfa Approach*

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ABSTRACT

This study used stochastic frontier analysis to determine the level of efficiency of health-care expenditure using three health outputs among low- and middle-income countries in Africa, from 2002–2011. The technical efficiency result shows that; among the health outcomes estimated, life expectancy at birth recorded higher efficiency among both low and middle-income African countries, while Anti-retrieval was the least efficient outputs. The study also calculated the expenditure savings when maximum efficiency is attained, where the average was 0.21 % and 0.29% of GDP for low and middle income countries respectively. The study recommends that governments improve not only health care expenditure but also factors affecting health other than health care. to reduce the burden on health-care facilities and reduce the burden of disease in the region.

Keywords: Health care Expenditure, Efficiency, Stochastic Frontier Analysis, Africa

1. Introduction

Efficiency of health-care expenditure has been an issue of great interest to many governments and the private sector, as well as health economists globally. This is because measuring efficiency of health-care expenditure plays a significant role in the evaluation of the health-care system performance in improving the health outcomes of the population. In Africa, the ability to adequately meet health care needs is exacerbated by extensive inefficiencies, (Jehu-appiah et al. 2014). Assessing efficiency of health care system is in line with the recommendation by the World Health Organization (WHO)'s Scientific Peer Review Group report which suggested a continuing research in the field of health care efficiency as an on-going program. In response to the recommendation, one of such efficiency research came in in 2000, where WHO made an attempt to develop econometric methodology and estimate efficiency of national health care systems. 2000 (WHO, 2000) presented rankings of countries' health care systems by their estimated efficiency, generating much debate, both political and academic, (Oglobin 2011). This study is in line with the above WHO suggestion focusing on African countries

African countries remain one of the regions with the lowest health-care expenditure and a high burden of infectious and parasitic diseases. It was widely reported that increasing public health-care expenditure may not significantly affect health outcomes if the efficiency of the spending is low (Grigoli & Kapsoli 2013).

In view of the inefficiencies in African health care system, experts in the field of efficiency analysis conducted several studies to guide African countries in the development of interventions to reduce waste of scarce resources, provide a vibrant and efficient health care delivery system particularly through an efficient health care spending. Ismail; (2010), Kirigia, et al. (2008), Renner et al. (2005) adopted the Data Envelopment Analysis (DEA) methods to measure efficiency despite its shortcomings. This study contributes to literature by applying a Stochastic Frontier Analysis (SFA) to compare the level of efficiency of health care expenditure among low and middle income countries in Africa.

Also, previous studies focused on "micro level" Akazili, et al; (2008), Kirigia et al (2004) or on comparative analysis of efficiency among regions (Grigoli & Kapsoli 2013; Gupta & Verhoeven 2001). The interregional studies on efficiency of health care delivery services indicate a substantial gap between Africa and other regions in terms of health-care efficiency resource utilization. And most studies. At the same time, few efficiency studies in Africa used SFA example, Kock & Slabbert (2012), with a focus on a specific aspect of hospital services (specialist surgeon clinics). This study therefore contributes to literature by quantifying efficiency of health care expenditure and calculating the potential expenditure savings due to efficiency of health care expenditure among the two income levels. Thus, the study presents the significant differences in efficiency of health care resource utilization across fifty African countries according to their income level as well as the potential expenditure gain as a result of efficiency attainment on health care expenditure.

This paper is structured into five sections with section one as the introduction, section 2 is the literature review, methodology is section three and sections four and five present the findings and conclusion of the study respectively.

2. Literature Review

The theoretical basis for efficiency analysis can be traced to the neo-classical production function, also known as 'the traditional production function', which has been one of the fundamental methods of explaining the relationship between factors of production (inputs and outputs). Production function theory has been widely used for empirical studies of efficiency analysis, particularly using SFA for efficiency estimation, due to its application of the input and output process. Studies such as those of Cos and Moral-Benito (2011), Mastromarco (2008), Evans et al. (2000), and Grigoli and Kapsoli (2013), have adopted the production function approach using SFA to estimate efficiency of health-care expenditure. The role of efficiency of health-care expenditure in improving health status has been emphasized by several researchers. For example, it was argued that, efficiency in health-care expenditure has a strong positive correlation with the level of health outcomes; accordingly, efficient utilization of health-care resources could improve health outcomes by 40 per cent in a typical sub-Saharan Africa countries (Murray, Kreuser, & Whang 1994). Additionally, Koopmans (1951), argues that improvement in health outcomes is a result of an efficient health-care system.

Studies on the efficiency of government spending have developed broadly along four lines. First, some studies have concentrated on gauging and enhancing efficiency in practical applications, often focusing on certain types of government spending in a specific country. Second, the efficiency of governments has been addressed in quantitative terms, using data on inputs of government spending but not on outputs. Third, some studies have assessed the efficiency of public spending using outputs but not inputs. A number of studies have looked at both inputs and outputs; these studies, however, typically have not made a consistent comparison of the efficiency of government spending across countries, (Gupta & Verhoeven 2001).

Specific studies on the continent of Africa have applied either of DEA or SFA to estimate efficiency of health care delivery services. Kock & Slabbert, (2012) used SFA to estimate the technical efficiency of specialist surgeon practices based in Gauteng Province, South Africa. Using a single and multiple output production functions in a framework of fixed effects models, they suggest that efficiency averages around 50% for this sample and is convex in years of surgical experience. The authors acknowledged the shortcomings in data used but conclude that specialty surgeons in Gauteng are wasting resources, even though the results suggest that resources could be more appropriately allocated in the province.

In additional, Kirigia et al. (2001), found that of the that eight forty-seven percent (47%) of the hospitals sampled in South Africa are technically inefficient, with average efficiency scores of 61% with a magnitude of scale inefficiency of 59%. Similarly, Renner et al., (2005) revealed that twenty-two (59%) of the 37 health units studied were found to be technically inefficient, with an average scores of 63%, and further analysis revealed that 24 (65%) of the health units were found to be scale inefficient, with an average efficiency scores of 72% in Sierra Leone. Akazili at al. (2008a), conducted two separate studies in Ghana, using DEA. They show that 65% of health centers are technically inefficient, and the other result revealed that 78% of health centers were technically inefficient. Further study also found that 88% of the health centers were allocative inefficient with the overall 90% inefficient, Akazili, et al (2008b).

Kirigia, et al. (2008) utilized a 3-year panel data set from all 28 public hospitals in Angola. They show that on average, productivity of municipal hospitals increase by 4.5% over the period 2000-2002. The growth was attributed to improvements in the efficiency not due to innovation. Ismail (2010) estimated the TE in states owned hospitals for the year 2007 using DEA. He suggest that six (6) states out of 15 were technically inefficient under constant return to scale (CRS), while five (5) states were technically inefficient under variable return to scale (VRS). Furthermore, the result revealed that 6 states were scale inefficient, out of which three (3) states were operating under decreasing return to scale (DRS) and the remaining three (3) were operating under increasing return to scale (IRS). The study suggests that government should increases access to health institutions through redistribution of health institutions within each inefficient state.

On African countries particularly, several studies used either one or both of the two popular approaches to estimate efficiency of health care delivery services within African countries. For example, Kock & Slabbert, (2012) used SFA to estimate the technical efficiency of specialist surgeon practices based in Gauteng Province, South Africa. Based on single and multiple output production functions, using fixed effects models, the results suggest that efficiency averages around 50% for the sample and is convex in years of surgical experience. Due to shortcomings in data used, it is inconclusive to conclude that specialty surgeons in Gauteng are wasting resources, even though the results suggest that resources could be more appropriately allocated in the province.

Studies on health-care delivery services across countries and region have been conducted. Grigoli and Kapsoli (2013) applied stochastic frontier model to quantify the inefficiency of public health-care expenditure and the associated potential gains for emerging and developing economies. They suggest that African economies have the lowest efficiency at current spending levels, and that Africa could boost life expectancy by up to about five years if they adhered to efficiency best practices. From the above literatures reviewed, it appears that most of the studies were more or less comparatives in nature, or focused on single country analysis of efficiency.

Thus, this study compares the efficiency of health care expenditure among low and middle income countries in Africa, as well as calculating the potential expenditure saving when maximum efficiency is attained.

3. Data and Methodology

The selection of variables for estimation in this study is in line with the model developed by (Evans et al 2000). He used a production function approach for the estimation of efficiency of health care expenditure. This study presents Life Expectancy at Birth Years, Ant-retroviral Therapy and Diphtheria Pertussis and Tetanus as health outputs (dependent variables). On the other hand, we use five health-care input variables: Health expenditure per capita, GDP per capita measured as PPP 2011 international. Population Density measured as housing conditions, Average schooling years representing level of education, Access to clean water and Access to sanitation facilities to represent factors affecting health other than health care. In line with SFA approach all variables are in natural logarithms. Data for the above variables are annual data and were sourced from WDI (2013).

In line with literature, the microeconomic efficiency can be traced to studies by Koopmans (1950), Debru (1951) and Farrel (1957), while the development of the modern SFA began with the introduction of the stochastic frontier production function by Aigner, Lovell and Schmidt (1977) in pioneered publications using SFA. SFA is one of the approaches used in efficiency estimation with the goal of calculating an economically reliable frontier including a production function or a cost frontier, providing for noisy or stochastic factor from the economic data. If a production function such as equation (1), was estimated using ordinary least squares (OLS), the resultant estimates will be located in the middle of the data points and the production frontier will not be obtained. SFA therefore, improves upon the OLS averaging process through the decomposition of the OLS error into a statistical noise component and a technical efficiency component, (Kock & Slabbert; 2012). Technical detail of SFA as described by (Kock & Slabbert; 2012, and Cos & Moral-Benito; 2011).

To assess the efficiency of health-care expenditure in Africa, this study adopt a framework from Cos and Moral-Benito (2011), Mastromarco (2008), Evans et al.(2000). In line with production function theory, by analyzing the relationship between inputs and outputs, we consider the following parametric production function in the form of;

$$Y_{it} = \alpha_i + X_{it}\beta_{it} + \delta Z_{it} + \varepsilon_{it} \dots\dots\dots(1)$$

$$\text{And } \varepsilon = \lambda_{it} - \mu_{it}$$

Where, Y represents the log of health output (LEBY, ART and DPT), α is the slope coefficient, i and t are vectors of countries and time, X is a vector of logs of input variables (HEXPC, GDPC). While Z, is a vector of logs of covariates (lnPOPDNS, lnAVYSCHL, lnACLW and lnASNTF) which affect health other than health care. And β and δ are the vectors of parameters. And ε is the compound error term decomposed in to the normal disturbance term and a one-sided disturbance term representing inefficiency parameters. However, λ and μ are assumed to be independent of each other and independently and identically distributed across observations. Lastly, ε represents sources of random change in the model and $U_i > 0$ is a non-negative random variable which represents the specific inefficiency of each country. This study estimates and analyses technical efficiency which according to Farrell (1957) defined as the ratio of the firm's observed output and the maximum obtainable input on the frontier given observed factor utilization. Within the context of health-care services, technical efficiency may refer to the physical relationship between the resources allocated (capital, labour and equipment) and certain health outcomes, including life expectancy (Moshiri & Aljunid 2010).

To calculate the potential expenditure saving as a result of attainment of efficiency of health care expenditure among low and middle income African countries, we adopt a model from Cos & Moral-Benito, (2011). Accordingly, given the watched contrasts in health system administration efficiency levels across countries, one can contend that if a given nation consolidates its resources proficiently, it could "create" the same yield (i.e. the same life expectancy) with fewer resources, specifically, with lower health expenditures. With the point of measuring this potential saving in monetary terms, we consider the accompanying mathematical statement relating life expectancy to expenditure and health care efficiency.

$$LE = \beta_1 EF_i + \beta_2 HE_i + \beta_3 \chi Y_i + \varepsilon_i \dots\dots\dots(2)$$

Where, LE represents health output (LEBY) for country i, EF is the efficiency estimates of the health output, HE is the country's health care expenditure per capita. While χY are vectors of others covariates which affect health other than health care that are in line with literature for example Evans et.al, (2000).

The estimated coefficients for the level of efficiency and per capita health care expenditure are both positive and significant (t-ratios 0.27 and 0.007 for middle-income countries, while low-income countries according to the estimates had positive and significant efficiency level with negative and insignificant health care expenditure at the prevailing level (t-ratios of 0.76 and -0.001 for low-income countries) respectively. That is to say, both a higher level of efficiency and a higher level of health care expenditure would increase life expectancy

in middle income countries while higher level efficiency will increases life expectancy but at the prevailing level of health expenditure per capita reduces life expectancy among low-income countries. However, for example the estimated elasticity for the level of efficiency is 0.27 against the elasticity of 0.007 estimated for per capita health care expenditure in middle-income countries. This means that an increase of 1% in health care efficiency would translate into an improvement in life expectancy of 0.277% compared with an improvement of 0.07% that would result from increasing health care expenditure by 1% in middle-income countries.

Subsequently, the following counterfactual exercise is conducted: using the estimated parameters that relate life expectancy to efficiency and health care expenditure

($\hat{\beta}_1$ and $\hat{\beta}_2$), the per capita health care expenditure (HE*) that would be compatible with the *ith* country maintaining its life expectancy constant (LE) is calculated, but situating the level of efficiency at its maximum (EF MAX), this latter variable corresponding to the most efficient. That is to say:

$$HE^* = HE_i + \frac{\hat{\beta}_1}{\hat{\beta}_2} (EF - EF^{MAX}) \dots \dots \dots (3)$$

Once the health care expenditure needed to hold life expectancy constant but assuming the maximum level of efficiency of the sample has been calculated, we can obtain the potential saving in country i's health care expenditure (PS*) as a percentage of GDP if the maximum level of efficiency is attained in the following way

$$PS^* = \frac{HE - HE^*}{GDPC_i} \dots \dots \dots (4)$$

Equation (4) was used as the expenditure saving calculation framework for both low and middle-income countries.

4. Result and Discussion

Table 1: Descriptive Statistic

Low-Income Countries			Input Variables		
Output Variables	Mean	Std. Dev.	Mean	Std. Dev.	
LEBY	0.605	0.010	lnHEXPC	1.571	0.341
DPT	4.324	0.296	lnAVYSCHL	1.834	0.115
ART	1.559	0.286	lnPOPDNS	3.903	1.269
			lnACLW	1.791	0.095
			lnLACCSF	1.368	0.267
Middle-Income Countries			Input Variables		
Output Variables	Mean	Std. Dev.	Mean	Std. Dev.	
LEBY	0.634	0.050	lnHEXPC	2.452	0.302
DPT	4.458	0.159	lnAVYSCHL	1.788	0.143
ART	1.476	0.450	lnPOPDNS	3.537	1.415
			lnACL	1.898	0.085
			lnLACCSF	1.670	0.283

Health Outputs: Life Expectancy at Birth Years (lnLEBY), Diphtheria Pertussis and Tetanus (lnDPT).; and Anti-Retroviral ln(ART). The inputs: Health Expenditure, (lnHEXPC), Average Schooling Years (lnAVYSCHL), Population Density (lnPOPDNS), Access to Clean water (lnACLW) and Access to sanitation facilities (lnACCSF).

Following Grigoli & Kapsoli (2013), in conducting efficiency analysis using SFA it is necessary to conduct a multicollinearity test to ensure that data used are free from multicollinearity problems (the situation where the correlations among the independent variables are strong, which increases the standard errors of the coefficients). According to the 'rule of thumb' for multicollinearity test using panel data, if the means of *Variance Inflation Factor* (VIF) is less than 10, and then there is no evidence of a multicollinearity problem. In line with the multicollinearity test rule of VIF less than 10, as highlighted above, the test result obtained for both low and middle-income countries, showed a mean VIF of low and middle income countries was 1.39 and 1.41 respectively. These statistics indicate that there is no evidence of multicollinearity problem in the data used for this analysis. Results for this test are presented in table 2 below.

Table 2: Pre-estimation Test for Multicollinearity
lnLEBY, ART and DPT: the output (dependent Variable)

Variable	Low-Income Countries' VIF	Middle-Income Countries' VIF
lnHEXPC	1.25	1.75
lnAVYSCHL	1.15	1.14
lnPOPDNS	1.48	1.08
lnACLW	1.62	1.32
lnLACCSF	1.45	1.74
Mean VIF	1.39	1.41

Author's Estimation, using SFA version 4.1 for LEBY (Life Expectancy at Birth Years), ART (Anti-Retroviral Therapy) and DPT (Diphtheria Pertussis and Tetanus) as health outputs against five inputs: lnACLW (access to clean water), lnPOPDNS (population density), lnASNTF (access to sanitation facilities) and lnHEXPC (health care expenditure per capita). Data from WDI 2013 for the period 2009-2011

Table 3: Summary of Technical Efficiency Estimates for Low and Middle-Income Countries
LEBY, ART and DPT AS HEALTH OUTPUTS

OUTPUT Low-income countries	Range of Efficiency Estimates	Frequency	OUTPUT Middle-Income Countries	Range of Efficiency Estimates	Frequency
LEBY	0.90-0.99	24	LEBY	0.80-0.89	1
	1.00	7		0.90-0.99	19
ART	30-39	1	ART	1.00	2
	40-59	1		20-29	1
	60-69	3		30-39	1
	70-79	10		40-49	1
	80-89	6		50-59	2
	90-99	8		60-69	3
	1.00	-		70-79	4
DPT	80-89	6	DPT	80-89	8
	90-100	8		90-99	1
	40-49	1		1.00	-
	5059	2		-	-
	60-69	2		-	-
	70-79	7		60-69	22
	80-89	10		70-79	7
	90-99	7		80-89	9
	1.00	0		90-99	1
	-	-		1.00	1

Author's Estimation, using SFA version 4.1 for LEBY (Life Expectancy at Birth Years), ART (Anti-Retroviral Therapy) and DPT (Diphtheria Pertussis and Tetanus) as health outputs against five inputs: lnACLW (access to clean water), lnPOPDNS (population density), lnASNTF (access to sanitation facilities) and lnHEXPC (health care expenditure per capita). Data from WDI 2013 for the period 2009-2011

From table 3 above, statistics show that 22 low income countries (see list in chart 1) recorded efficiency scores between 0.90 to 0.99, representing 75.9% of the total countries in that particular income level. This level of efficiency estimates could be compared with efficiency attainment of 0.98-1.00, by some OECD countries such as; Spain, Turkey, Portugal among others in 2011, (Cos & Moral-Benito 2011). In comparison, Spain's health care expenditure per capita (PPP) in 2011 and life expectancy were \$3001 and 82 years respectively, and Turkey recorded health care expenditure per capita of \$ 943 (PPP) and 74 years life expectancy in the same period. Some of the above African countries also have relatively lower health care expenditure and life expectancy as compared to their those in OECD, for example, Burkina Faso` health care expenditure per capita in 2011 was \$ 90 (PPP) and 55 years life expectancy, Mozambique recorded health care expenditure per capita of \$61 and 49 years life expectancy.

Also among these African countries, Tanzania and Malawi each spent \$1167 and \$80 with a corresponding life expectancy of 60 and 54 years respectively. Similarly, 7 countries (Ethiopia, Madagascar, Kenya, Niger, Rwanda, Senegal and Mauritania), achieved efficiency estimates of 1.00. These countries have attained full efficiency in life expectancy at birth as health output. This finding is consistent with Gupta and

Verhoeven (2001), who show that, some of the low-income African countries such as Gambia, Burkina-Faso, Togo, Guinea, Kenya, Tanzania and Zambia have attained 100 per cent efficiency in their health inputs utilization. From the above table, on output ART 8 countries (Benin, Chad, Eritrea, Ethiopia, Guinea, Kenya, Rwanda and Senegal) 90-99 efficiency estimates against the average of 0.78. Similarly, 7 countries (Burkina Faso, Eritrea, Madagascar, Senegal, Sierra Leone, Zambia and Mauritania) attained efficiency estimates between 0.90-0.99 on DPT output against the average score of 0.80 on the output. However, none of the countries achieved full efficiency of 1.00 on both ART and DPT outputs.

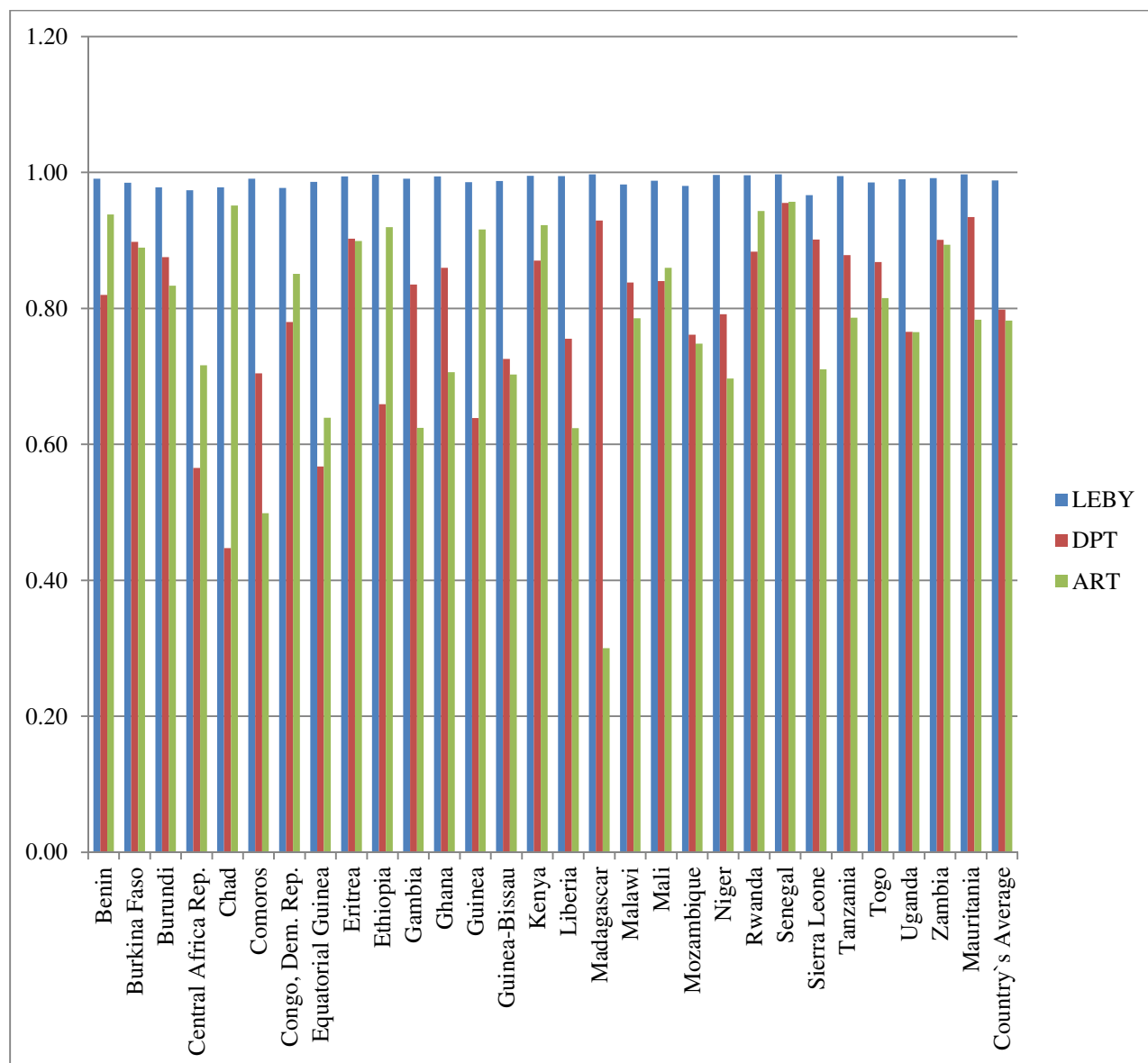
On the other hand, the above table 3 revealed that on LEBY output, 1 country (Sudan) has obtained efficiency scores of 0.81 which is the lowest among middle-income countries. And 19 (See list in chart 2), recorded efficiency scores between 0.90-0.99 representing 85.7 % of the middle income countries. From the result moreover, 2 countries (Algeria and Sao Tome) have achieved full efficiency of 1.00 scores among the countries. This level of efficiency could also be compared with health care expenditure efficiency attained by Australia and Switzerland in 2011 as reported by (Cos & Moral-Benito 2011), where, Australia had \$3926 as health care expenditure per capita PPP and life expectancy of 81 years, and Swaziland with a record of \$5701 health care expenditure per capita, with a corresponding life expectancy of 82 years in 2011. Accordingly, Algeria with health care expenditure per capita of \$647 PPP and life expectancy of 70 years, while Sao Tome and Principe recorded \$223 health care expenditure per capita and life expectancy of 66 years in 2011.

The comparison of efficiency estimates, health care expenditure and life expectancy between some low and middle income African countries with some OECD members, it is worth mentioning that there is a substantial improvement in efficiency of health care expenditure in Africa, as opposed to previous conclusion by (Grigoli & Kapsoli; 2013 and Evans *et al.*; 2000). Table () also shows that one country (Cameroon) among the middle-income countries recoded the highest efficiency scores of 0.96 on ART output, while at the same time, and Congo Rep. achieved full efficiency of 1.00 on DPT output across the Middle-income countries. Meanwhile, technical efficiency estimates for all countries is presented in chart 1 and 2.

From equation (4), where, $GDPC_i$ is the Per Capita GDP for county i , we calculate the potential savings emerging using SFA approach as discussed above. In this case, the average potential expenditure saving for low-income African countries is 0.21% of GDP and 0.29% for Equatorial Guinea as the highest and followed by Serra-Leone and Liberia with 0.26% each. While, the least record was Benin with 0.05% of GDP. On the other hand, the average potential expenditure saving was 0.29% of GDP among Middle-Income countries where, Mauritius recorded the highest of 0.37% followed by Angola with 0.34 and South Africa with 0.32%.

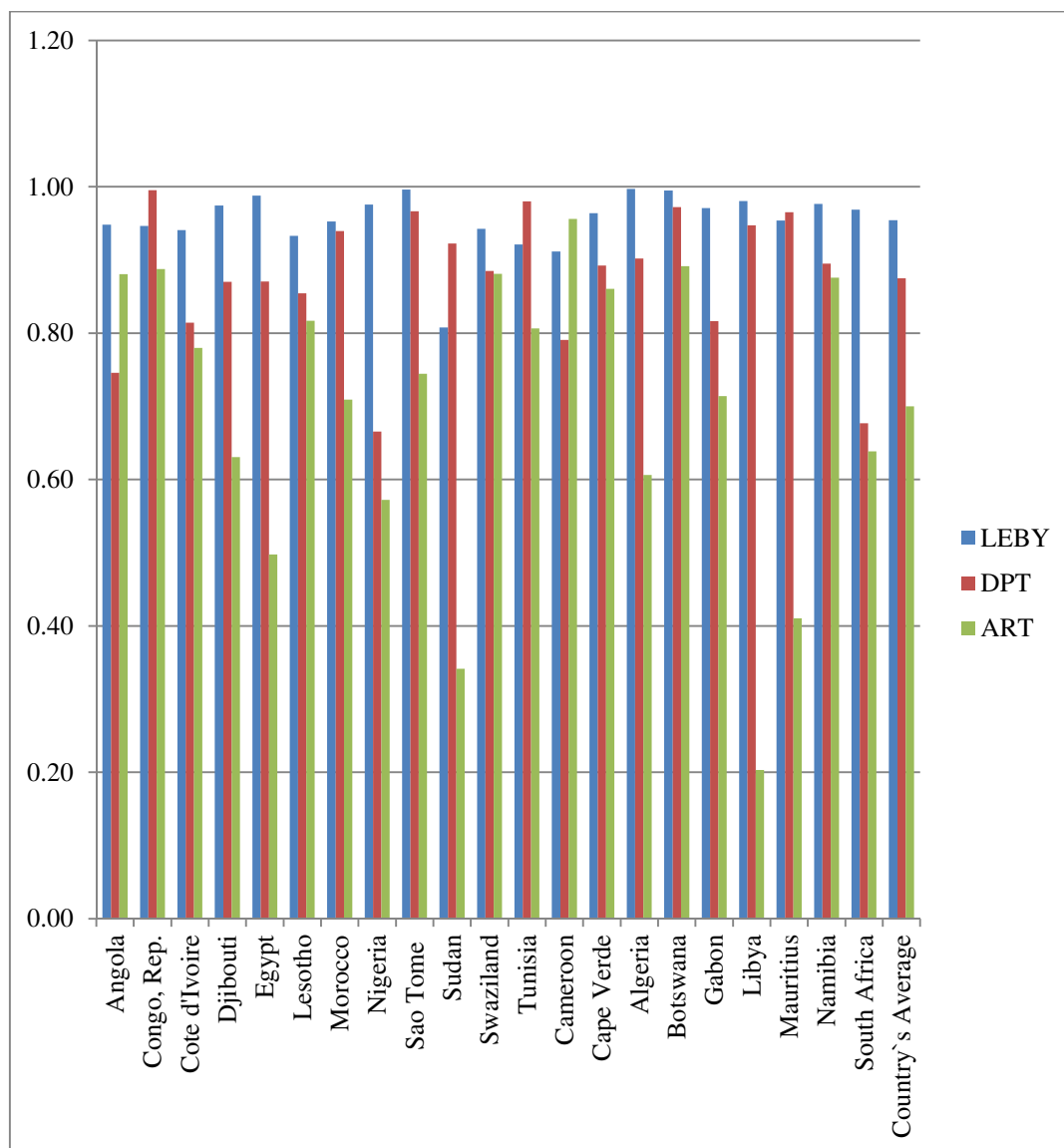
However, the above level of expenditure savings was far lower than the expenditure savings among OECD countries with the average expenditure savings of 2.5% of GDP and 1.2% for Spanish case (Cos & Moral-Benito 2011). The expenditure saving obtained for both low-and middle-income African countries is lower than the potential expenditures gains from reaching the regional average obtained by (Grigoli & Kapsoli, (2013), where African region recorded a savings of 6.5% and 0.4% on efficiency of both TB and HIV diffusion respectively. However, according to the authors, this type of result must be interpreted with care. They nevertheless provide an idea on how reforms affecting these variables could affect health outcomes. Result of the potential expenditure savings for both low- and middle-income African countries is presented in chart 3 and 4.

Chart 1 List of Low-Income Countries Technical Efficiency Estimates



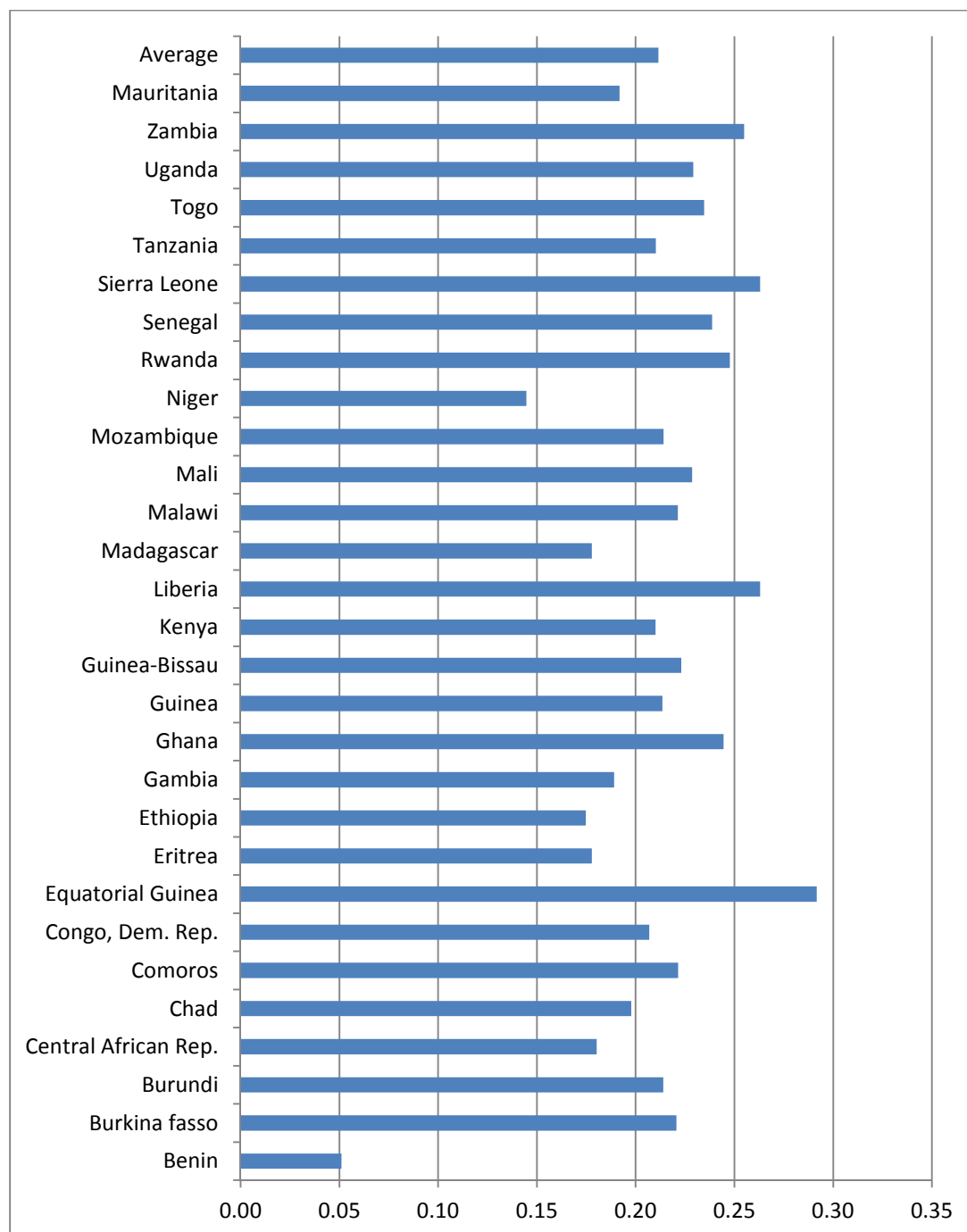
Author's Estimates, using SFA version 4.1 for LEBY (Life Expectancy at Birth Years), ART (Anti-Retroviral Therapy) and DPT (Diphtheria Pertussis and Tetanus) as health outputs against five inputs: lnACLW (access to clean water), lnPOPDNS (population density), lnASNTF (access to sanitation facilities) and lnHEXPC (health care expenditure per capita). Data from WDI 2013 for the period 2009-2011

Chart 2 List of Middle-Income Countries Technical Efficiency Estimates



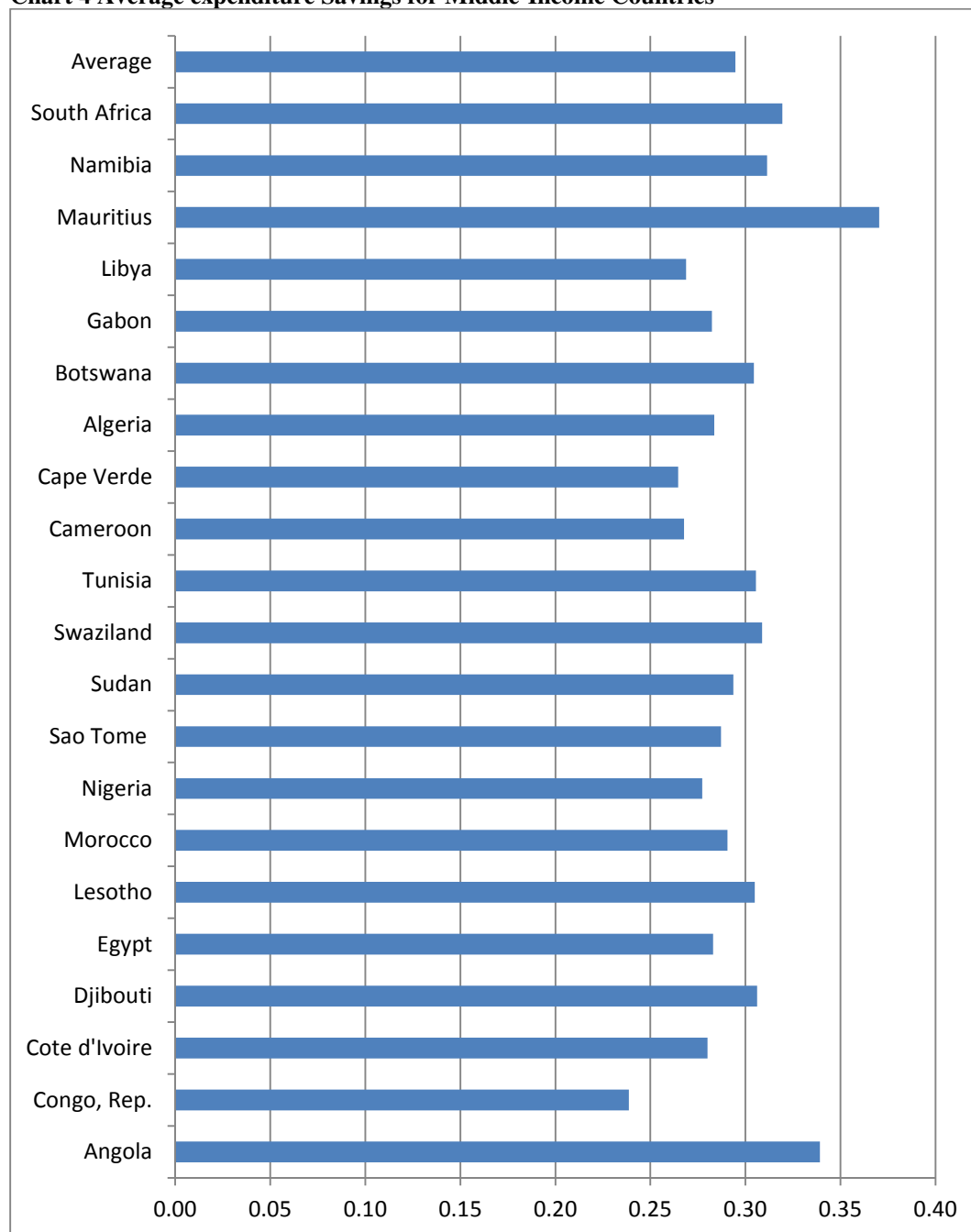
Author's Estimates, using SFA version 4.1 for LEBY (Life Expectancy at Birth Years), ART (Anti-Retroviral Therapy) and DPT (Diphtheria Pertussis and Tetanus) as health outputs against five inputs: lnACLW (access to clean water), lnPOPDNS (population density), lnASNTF (access to sanitation facilities) and lnHEXPC (health care expenditure per capita). Data from WDI 2013 for the period 2009-2011

Chart 3 Average expenditure Savings for Low-Income Countries



Source: Author's Calculation using formula adapted from Cos & Moral-Benito, (2011), using low-income countries Technical efficiency estimates of LEBY from SFA approach for the period 2009-2011

Chart 4 Average expenditure Savings for Middle-Income Countries



Source: Author's Calculation using formula adapted from Cos & Moral-Benito, (2011), using Middle-Income countries Technical efficiency estimates of LEBY from SFA approach for the period 2009-2011

5. Conclusion and Policy Implication

To examine the efficiency of health-care expenditure which is the sole aim of this paper, the study estimated three health-care outputs using five different health inputs. The results revealed that in low-income African countries the LEBY health outcome had 0.99 efficiency estimates. Also, DPT and ART had 0.80 and 0.78 efficiency level respectively. On the other hand, in middle-income African countries the average efficiency of LEBY was 0.95 and DPT and ART recorded average efficiency of 0.87 and 0.70 respectively. The study also calculated the expenditure savings when efficiency was attained for both low and middle income countries. According to the results, on average, the expenditure savings for low-income countries was 0.21% of GDP and 0.29% of GDP for middle income countries.

The health-care expenditure efficiency in both low- and middle-income African countries is found not

to be fully inefficient in this study. Therefore, governments in the region need to improve the level of efficiency of health outputs to attain maximum efficiency, by adopting best practices in their resource allocation to the health-care sector. This is consistent with the recommendation made by Gupta and Verhoeven (2001), that improving health-care expenditure in Africa requires not only higher budgetary allocations, but also the adherence to efficient resource allocation and management, through control of corruption and effective policy formulation and implementation.

Again, since it was established and as considered in this study, stakeholders in the health sector need to put more efforts to improve factors affecting the health of the people other than health care, such as: access to clean water, sanitation etc. This measure might reduce the burden on health-care facilities thereby leading to better use of such facilities as it might enhance health-care delivery and reduce the burden of disease in the region.

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