

**UNIVERSITY OF GHANA**

**EFFICIENCY OF GOVERNMENT EXPENDITURE IN THE  
ECOWAS SUB-REGION**

**BY**

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA,  
LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR  
THE AWARD OF MPhil ECONOMICS DEGREE**

**DEPARTMENT OF ECONOMICS**

**SCHOOL OF SOCIAL STUDIES**

**JULY, 2015**

## DECLARATION

I, Aloka Innocent Koku, the author of this thesis titled “**EFFICIENCY OF GOVERNMENT EXPENDITURE IN THE ECOWAS SUB-REGION**”, hereby declare that, this work was done entirely by me under supervision at the Department of Economics, University of Ghana, Legon from August 2013 to July 2015.

This work has never been presented either in whole or in part for any other degree at this University or elsewhere, except for past and present literature, which have been duly cited.

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## ABSTRACT

Efficiency of government expenditure is very important in the management of every economy since outcomes depend on the ability of resources to reach their target destination. Governments all over the world spend a high percentage of their GDP annually and countries in the ECOWAS sub-region are no exception. With efficiency, countries can achieve better outcomes with the same level of spending or even less. This study, therefore, seeks to examine the relationship between government spending on education and health and outcomes in the ECOWAS sub-region; estimate the efficiency of government spending in education and health; compare the efficiency of government spending among countries in the sub region and finally examine the governance and institutional factors that determine the variation in this efficiency among countries. Panel data for the 15 countries from 2002 to 2011 was employed. We explored the fixed and random effect models in panel regression to address the first objective. We estimated efficiency and explored its determinants using the Stochastic Frontier Analysis (SFA). Results show a negative relationship between public spending and primary enrolment and it is not statistically significant. The relationship between public spending and life expectancy is positive but weak. Results show that public health spending has a negative and significant impact on infant mortality rate. The effect of public expenditure on primary enrolment is positive but not significant. Per capita income, however has a significant impact on enrolments. Control of corruption, political stability and technological changes were identified as the main determinants of efficiency. Results also indicate that countries in the ECOWAS sub region are operating at efficiency levels of 59% for the health sector and 52% for the education sector. Based on the finding, the study recommended among other things that government should do everything possible to eliminate

corruption, make jobs available to the citizens and ensure that wastage in spending is minimized as much as possible.



## DEDICATION

This thesis is dedicated to my wife, Mrs Jemima Ayikoe Aloka, and to my parents, Mr. and Mrs. Winston Aloka for the love and support they have shown throughout my education.



## ACKNOWLEDGEMENT

I am most grateful to Jehovah God for his many blessings and grace during my study. I owe Jehovah God all the praise. I extend a heartfelt appreciation to the Department of Economics, University of Ghana, Legon for offering me this opportunity to pursue a master's degree in economics and deepening my knowledge in this field.

My warmest appreciation goes to my supervisors, Dr. Alfred Barimah and Dr. Michael Danquah, for their kind assistance and challenging questions that helped shaped the course of this thesis. It is their guidance and comments that gave shape and meaning to this work. To Dr Michael Danquah, of the Department of Economics, who had always been available to offer extra lessons on the use of the Stochastic Frontier Approach. I must confess his seminars on the use of the methodology developed my interest in this field. I acknowledge the warm friendship and times we spent together on this thesis.

I also appreciate the efforts of my wonderful course mates who were available to assist anytime I called on them. Though numerous, special mention goes to Mr Abbease Harry, Mr. Newman Ayikoe , Sampson Senahey, Nyamadi Godfred, Salomey Kotin and Gloria Quarshie. I thank these people for all the love they showed during my time of study. To my wonderful parents Mr. and Mrs. Winston Aloka ; I thank them all for their love, patience and support. Finally to my dear wife Mrs. Jemima Ayikoe Aloka for her unflinching support and understanding when I had little time for her. I thank you for all the love.

**TABLE OF CONTENT**

<b>Content</b>	<b>Page</b>
DECLARATION .....	i
ABSTRACT.....	ii
DEDICATION.....	iv
ACKNOWLEDGEMENT .....	v
TABLE OF CONTENT .....	vi
LIST OF TABLES .....	ix
LIST OF FIGURES .....	x
ABBREVIATIONS .....	xi
CHAPTER ONE .....	1
INTRODUCTION .....	1
1.1 Background to the study .....	1
1.2 Problem statement.....	4
1.3 Objectives of study .....	6
1.4 Research Question .....	7
1.5 Justification.....	7
1.6 Organization of the study.....	8
CHAPTER TWO .....	10
LITERATURE REVIEW .....	10
2.1 Introduction.....	10
2.2 Theoretical review .....	10
2.2.1 What is economic efficiency?.....	10
2.2.2 Measurement of efficiency .....	17
2.3 Empirical review .....	26

2.3.1 Literature on the link between Health and Education Expenditures and Outcomes .....	27
2.3.2 Empirical literature on the efficiency of government expenditure .....	34
CHAPTER THREE .....	40
OVERVIEW OF GOVERNMENT EXPENDITURE AND OUTCOMES .....	40
3.1 Introduction.....	40
3.2 A brief history of ECOWAS.....	40
3.2.1 Outcomes of health delivery in the sub-region. ....	41
3.3. Public Health Expenditure in the ECOWAS Sub-Region .....	49
3.4 Education Outcomes in the ECOWAS Sub-Region .....	51
3.5 Government spending on education.....	58
CHAPTER FOUR.....	61
METHODOLOGY .....	61
4.1 Introduction.....	61
4.2 Conceptual Framework.....	61
4.3 Analytical Framework .....	63
4.3.1 The Stochastic Frontier Analysis .....	66
4.4 The Empirical Model .....	72
4.5 Fixed Effect and Random Effect models .....	76
4.6 Variable description and expected sign. ....	78
4.7 Source of data. ....	82
CHAPTER FIVE .....	84
DATA ANALYSIS AND DISCUSSIONS .....	84
5.1 Introduction.....	84

5.2 Summary statistics of data .....	84
5.3 Analysis of the Econometric Results .....	86
5.4 Stochastic frontier analysis and technical efficiency estimates .....	91
5.4.1 Technical efficiency estimates .....	96
5.4.2 Determinants of efficiency of government spending.....	99
CHAPTER SIX.....	101
SUMMARY OF FINDINGS, CONCLUSION AND POLICY RECOMMENDATIONS.....	101
6.1 Introduction.....	101
6.2 Summary of Findings.....	101
6.3 Conclusions.....	103
6.4 Policy Recommendations.....	104
6.5 Recommendation for future research.....	106
REFERENCES .....	107

**LIST OF TABLES**

Table	Page
3.1: Life Expectancy in West Africa.....	44
3.2: Prevalence of HIV in West Africa.....	47
3.3: Incidence of tuberculosis .....	48
3.4: Public Expenditure on Health (% of GDP).....	50
3.5: Primary Enrolment in West Africa .....	55
3.6: Secondary Enrolment Sub Saharan Africa .....	55
3.7: Tertiary Enrolment in West Africa .....	56
3.8: Government expenditure on education as a percentage of GDP .....	60
4.1: Variables and Expected Signs.....	81
4.2; Summary of variables, description and sources.....	83
5 1: Country specific mean of variables .....	85
5.2: Summary statistics of government spending and outcomes .....	86
5 3; Random-effect GLS regression showing relationship between primary enrolment and other variables.....	88
5.4; Hausman test.....	89
5.5: Panel Regression for life expectancy.....	90
5.6: Maximum likelihood Estimates of variables showing Efficiency of Public Spending on Infant Mortality rate .....	92
5.7: Maximum Likelihood Estimates showing efficiency of Public Education Expenditure on Secondary Enrolment.....	94
5.8: Maximum Likelihood Estimates showing efficiency of Public Education Expenditure on Primary Enrolment.....	95
5.9: Technical Efficiency estimates .....	97
5.10: Distribution of technical efficiency of public spending in education .....	98
5.11: Distribution of technical efficiency estimates of government spending on health .....	98

**LIST OF FIGURES**

Figure	Page
2.1: Edgeworth Box for Consumption .....	13
2.2: Pareto-Efficiency in production.....	14
2.3: Technical and allocative efficiency .....	20
2.4: FDH production possibility frontier .....	22
3.1: Maternal Mortality in West Africa .....	45
4.1: Output orientated Efficiency measure .....	62
4.2; A Debreu – Farrell measure of technical efficiency .....	63

**ABBREVIATIONS**

CC	Control of Corruption
CIA	Criminal Intelligence Agency
COLS	Corrected Ordinary Least Squares
CPIA	Country Policy and Institutional Assessment
DALE	Disability Adjusted Life Expectancy
DEA	Data Envelopment Analysis
ECOWAS	Economic Community of West African States
EFA	Education For All
FDH	Free Disposable Hull
GDP	Gross Domestic Product
HIPC	Highly Indebted Poor Countries
IMR	Infant Mortality Rate
LE	Life Expectancy
MDG	Millennium Development Goals
MMR	Maternal Mortality Rate
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PE	Primary Enrolment
PEE	Public Expenditure on Education
PEH	Public Expenditure on Health
PS	Political Stability
SE	Secondary Enrolment
SIDS	Small Island Development States
SPF	Stochastic Production Frontier

SSA	Sub-Saharan Africa
TE	Tertiary Enrolment
U5MR	Under Five Mortality Rate
UN	United Nations
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFPA	United Nations Population Fund
UNICEF	United Nation Children Fund
WDI	World Development Indicators
WHO	World Health Organisation

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Background to the study**

Public expenditure plays an important role in the management of the economy. It is through public expenditure that governments provide various types of infrastructure, public goods and services and also adopt various fiscal measures to ensure stability and stimulate economic activities and growth (Santiago and Gaobo, 2005). Government spending helps to guide the pace of a country's economic activity. It helps a country to maintain a steady growth and price stability and also ensure high level of employment. By adjusting spending and tax rates, it can speed up or slow down a country's rate of growth thereby affecting levels of prices and employment. In addition public spending lays down the right infrastructure for private sector development.

Governments the world over, therefore spend a greater proportion of their GDP annually, though developed countries tend to spend a greater proportion as compared to their counterparts in the developing nations. Governments of developing countries spend between 15 and 45 percent of GDP annually. The efficiency with which these goods and services are provided is very crucial in macroeconomic stabilization and economic growth. Also, little changes in efficiency of public spending can have a great effect on GDP and on the attainment of other government objectives.

Health and education sectors are two major sectors of economies in the ECOWAS sub-region. A high proportion of government expenditure within the sub-region is channelled into these sectors i.e. education and health. The education sector is very important mainly because of its role as a means of understanding, controlling and

redesigning human environment (CBN, 2000). It also improves health productivity and access to paid employment. Nelson Mandela once observed that education is the most powerful tool that can be used to change the world, as reinforced by Ola (1998) who states that “*if you see any economy that is not doing well, find out what is spent on education.*” According to the author, low economic performance can be attributed to low public spending on education and hence proposes a positive relationship between economic development and education spending. Most countries in the ECOWAS sub-region, therefore, spend a substantial percentage of their GDP on education. This is estimated to be between 3% and 8% annually (WDI, 2014).

The health sector also has a great impact on economic development of a nation. As Bloom and Canning (2000; 2004) puts it, a healthy individual is more productive at work, provides more labour hours, invest more in their own education and also saves more in expectation of a longer life. According to WHO, an increase of life expectancy at birth by 10% will increase economic growth rate by 0.35%. It is also estimated that 50% of the growth differential between the rich and the poor is due to ill-health and life expectancy. For this reason, the health sector of most countries in the ECOWAS sub-region has attracted huge financial and infrastructural investments from both government and private organisations. Over the past decade, public expenditure on health has been estimated between 1% of GDP to as much as 16% of GDP. Sierra Leone, for instance spent between 15% and 16% of GDP from 2002 to 2011, while Ghana on the other hand spent between 4% and 7% of GDP within the same time period (WDI, 2014).

Literature has well recognized the role of human capital in fostering economic development. Thus, non-governmental organizations, corporate bodies, international

bodies and even state institutions have justified higher government expenditure on human capital development based on its impact on (a) economic growth (Levine and Renelt, 1992; Mankiw et al., 1992; Barro and Martin, 1995; Barro, 1996a, b; and Martin, 1997; (b) individuals' lifetime incomes i.e., the social rate of return (for example, Anyanwu, 1996, 1998); and (c) fostering economic development and poverty reduction in general (Romer, 1986; Lucas, 1988; Squire, 1993; Ravallion and Chen, 1997; Sen, 1999; and Schultz, 1999). Better health leads to the effective and sustained use of the knowledge and skills that individuals acquire through education (Schultz, 1999). Barro (1996b) suggests further that better health can limit the depreciation of education capital, and hence increases the favourable effect of education on growth.

According to Arjona et al. (2001), there exists a positive association between certain types of social spending although there is no noticeable impact of social spending on growth at the aggregate level. Gyimah-Brempong and Wilson (2004), in their study, finds a positive and robust relationship between investment in health and growth in both sub-Saharan Africa and OECD countries.

The UN Millennium Declaration was agreed to in 2000 by 189 countries. These included countries from the ECOWAS sub-region. Both the developed, developing and under-developed countries pledged their commitment to attain improvements in human development by the year 2015. This commitment is summarized in the eight Millennium Development Goals (MDGs) that set targets in areas of poverty reduction, health improvements, education attainment, gender equality, environmental sustainability, and fostering global partnerships (UNDP, 2003). The eight goals are: eradicate extreme poverty and hunger; achieve universal primary education; promote

gender equality and empower women; reduce child mortality; improve maternal health; combat HIV/AIDS, malaria, and other diseases; ensure environmental sustainability; and develop a global partnership for development. The drive to achieve these MDG's outcomes has led to countries in the sub-region devoting a huge proportion of their budgets to these all important sectors i.e. health and education. In furtherance to achieving these MDGs, there have been calls for more funding to be allocated to the developing world so as to aid in the attainment of these goals. Critical among these calls have come from the WHO and UNESCO to the developed countries to increase their budgetary supports to poorer and less developed countries. In addition, developing countries have also been encouraged to increase their budgetary allocations to education and health sectors.

### **1.2 Problem statement**

Most governments in the ECOWAS sub region continue to spend a significant proportion of their GDP on education and health sectors. Over the past few decades, expenditure on education and health has recorded an increase in most countries in the ECOWAS sub region. However, the social outcomes do not match the huge budgetary allocations made in these sectors. Available data suggest that in spite of the huge capital expenditure in health care and education, there seems to be a rising trend in illiteracy and access to quality health care is still a major problem in the sub region. Countries in the sub-region are still plagued with high infant mortality rates, low life expectancy at birth, high maternal mortality and low primary and secondary school enrolments. According to the World Development Indicators (WDI, 2004), Nigeria for instance recorded a decrease in the net primary school enrolment from a figure of sixty seven percent (67%) in 2004 to a low of fifty eight (58%) in 2010. Surprisingly

however, Nigeria had the worst outcome worldwide in terms of the net primary school enrolment. In addition, most of the outcomes are the worst worldwide. For instance, thirteen countries have been identified by WHO as having the lowest overall life expectancy rates worldwide in 2013. Out of this number, three are from West Africa alone. They include Sierra Leone, Mali and Guinea Bissau. Details of these are discussed chapter three.

It has often been argued that increasing budgetary allocation for education and health alone may not necessarily lead to higher or more positive outcomes, but however the efficiency to which these resources are used for. More attention should be given to increasing the efficiency of the expenditure. With efficiency, countries can achieve more for a given level of expenditure or achieve the same outcome for a lower level of spending. Evidence about the positive relationship between education spending and outcomes is mixed and contradictory. This emphasizes the fact that government spending does not necessarily lead to improvement in outcomes and hence efficiency should be taken seriously. Governments can definitely reduce their spending and hence fiscal deficits through efficiency and still attain the same or better outcomes.

According to Gupta and Verhoeven (1999), governments can be viewed as producers engaged in the production of different outputs by combining labour with other inputs. For instance, governments finance teachers and books to reduce illiteracy, and pays for medical facilities and personnel to increase their populations' life expectancy. Countries that produce more output while spending less on inputs can be seen as more efficient as compared to countries that produce less output and use more inputs, other things being equal. In addition, the global financial crisis has prompted many

governments to seek efficiency savings in order to reduce budget deficits without affecting long-term growth prospects.

Recent trends in the health and education sectors within the ECOWAS sub-region show a sluggish nature to improvements in the overall development of these two sectors. In spite of the continual increases in funding and infrastructural development that has been seen over the years, the net returns for the capital investiture have seen little progress. Countries such as Ghana and Nigeria have seen some changes in the quality of health care and educational sectors, though a large majority of the countries continue to record declines in their stride to achieving improved health services and quality education. . In order to reap savings from inefficiencies, governments must be able to examine such inefficiencies and examine their root causes. One way to achieve this is through analytical work.

### **1.3 Objectives of study**

The main objective of this study, therefore, is to examine the efficiency of government expenditure in the ECOWAS sub-region. Specifically, the study seeks to:

- Examine the relationship between government expenditure in health and education and outcomes in the ECOWAS sub – region.
- Estimate the efficiency of government expenditure in the health and education sectors.
- Compare the efficiency of government expenditure among countries in the ECOWAS sub-region in education and health.
- Examine the governance and institutional factors that are most important in explaining the variation in this efficiency of countries at achieving outcomes.

#### **1.4 Research Question**

In the midst of these arguments, the research questions that arise are:

- What is the relationship between government expenditure in health and education and outcomes in the ECOWAS sub-region?
- How efficient are government expenditures in achieving social outcomes in education and health in the ECOWAS sub-region?
- In which countries are government expenditures most efficient in education and health?
- What governance and institutional factors are most important in explaining the variation in these inefficiencies?

#### **1.5 Justification**

The importance of efficiency of government cannot be over-emphasized. It is through efficiency analysis that government expenditures can be evaluated and measured. Over the past few decades, most sub-regional countries have seen a surge in public spending primarily in the areas of health and education. Recent developments within the sub-region suggest that educational levels and health quality has been steadily increasing though some member states continue to experience sluggishness in these two sectors. Studies on efficiency measurement have often been focussed on other sectoral analysis such as manufacturing and agricultural productivity. It is however important that to be able to make meaningful analysis of other sectors of the economies of members states, a holistic analysis is undertaken to find out the institutional bottlenecks that retards the growth of these sectors. The study thus seeks to find out how best governments within the sub-region are utilising the resources

available in improving the social well-being of its populace primarily with the areas of quality healthcare and education.

Some studies on efficiency analysis have been carried out in the past with mixed results on the efficiency of government spending. Similar studies have been done in the past for instance on the efficiency of the government spending in countries and areas like the Small Island Developing State (SIDS), Latin America and the Caribbean. However no such study has been undertaken in the ECOWAS sub-region. It is for this reason that there is the need to fill the gap in literature on the efficiency of governments spending. Previous studies on efficiency analysis on government spending have adopted the Data Envelopment Analysis (DEA) approach and the Free Disposable Hull approach to estimate efficiency. Just a handful of them have attempted the Stochastic Frontier Analysis.

These thus reinforce the need to adopt another approach in measuring government expenditure, since the results from different areas and authors have been mixed. This also explains why this study needs to be done on Ghana and her immediate neighbours in order to investigate the efficiency of government spending in health and education sectors. These two sectors of the economies are chosen primarily on the basis that a large proportion of government spending is channelled into these sectors.

### **1.6 Organization of the study**

This study is organized into six distinct chapters. Chapter one presented the background to the study, discussed the statement of the research problem and the research questions that arose, the objectives of the study and justification for this study. Chapter two reviews the literature in this study area. Both theoretical and

empirical literature in the areas of the measurement of efficiency and efficiency of government spending in education and health are reviewed in this chapter. Chapter three gives an overview government spending and outcomes in education and health in the ECOWAS sub – region. Chapter four, deals with the methodology adopted in this study. The fifth chapter presents and discusses the results from this study. The final chapter concludes the study and offers recommendations for policy based on the findings of this study. Limitations encountered in the course of this study as well as recommendations for further research are also presented in the concluding chapter.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter reviews the relevant literature for the study. The chapter is sub-divided into two thematic areas. These areas focus on the theoretical underpinnings of the stochastic frontier approach and the empirical review relates to studies that have applied this approach in the estimation of efficiency. The theoretical literature focuses on issues that relates to the various definitions of efficiency, its measurements and shortcoming of the approach. The fundamental ideals of the approach are also discussed. The empirical review explores various studies that have employed this approach in efficiency estimation and determination. The essence of this chapter is to bring to the fore the various theories that have been developed over time on efficiency, and its measurements and the various empirical studies that have been carried out on the efficiency of government expenditure and its determinants worldwide as well as identify the gaps and the areas that are yet to be covered.

#### **2.2 Theoretical review**

##### **2.2.1 What is economic efficiency?**

Economic efficiency refers to the ability to use resources in order to maximize the production of goods and services. An economic system can therefore be said to be more efficient than another economic system if it can produce more goods and services using the same level of resources or less or if it can make available the same level of goods and services using lower level of resources. Economic efficiency therefore implies that no other person or producer one can be made better off without

making the other person worse off, no additional output can be produced without increasing inputs and finally, production occurs at the least possible cost.

Efficiency was introduced in the early 1950s by Koopmans (1951). He gives the definition of an efficient point “ A possible point in the commodity space is called efficient whenever an increase in one of its coordinates (the net output of one good) can be achieved only at the cost of a decrease in some other coordinate (the net output of another good)”. In other words, for a point to be efficient, output must be maximized given the inputs.

Lovell (1993), in defining efficiency of a production unit, makes a comparison between some observed values of its output and inputs and some optimal or best practice values of its output and inputs. He explains that if the optimum is defined in terms of production possibilities, then efficiency is said to be technical but if it is defined in terms of behavioural goals, then efficiency is economic. The basic idea in microeconomics relates a production unit's decision making to the behavioural assumptions underlying production i.e. profit maximization and cost minimization. This assumption thus assumes that firms in making production decisions would always prefer to operate on the efficient frontier where maximum output is achieved. However this objective of efficient production is often not achieved due to inefficiencies that arise from production. Hence, the existences of technical inefficiency of production units have been at the fore of debate in current economic discussions.

Greene (2005) views efficiency as characterizing the relationship between observed production and some ideal or potential production. In case of single commodity, one

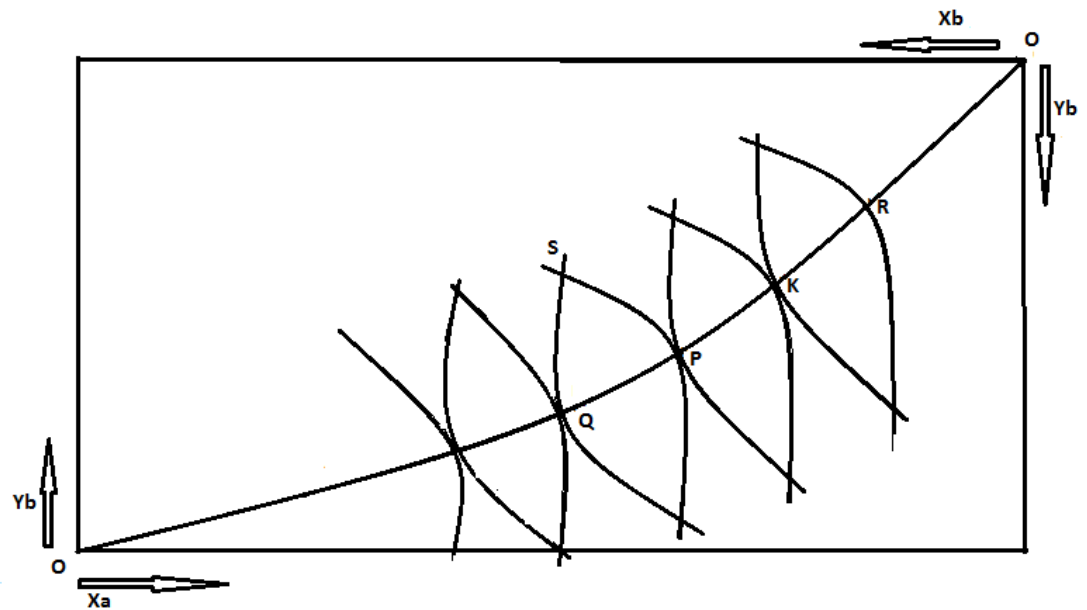
needs to look at efficiency in terms of factor productivity, i.e. the ratio of actual output to optimal value as specified by a production function.

In order to understand the concept of efficiency, we need to discuss its various components namely technical and allocative efficiency, scale, structural and Pareto efficiency.

#### **2.2.1.1 Pareto efficiency**

The term Pareto efficiency or optimality is named after an Italian Economist, Vilfred Pareto (1848–1923). He defines efficiency as the state of allocation of resources in which it is impossible to make anyone better off without making at least one individual worse off. In other words a particular configuration of the economy is Pareto efficient if no reallocation is possible that will leave at least one person better off and no one worse off. Moves that make some better off but no other person worse off are Pareto improvements.

By applying Pareto efficiency to consumption, we can say that the distribution of the given commodities X and Y between two consumers is efficient if it is impossible by the redistribution of these goods to increase the utility of one individual without reducing the utility of the other.



**Fig. 2.1: Edgeworth Box for Consumption**

The dimension of rectangle in fig 2.1 represents total available quantities of X and Y in a pure-exchange economy. Any point in the box shows a particular distribution of the commodities between two consumers. The indifference map of consumer A has O as the origin while consumer B has  $O^1$  as the origin. At any point on the contract curve, the marginal rate of substitution (MRS) is the same for the two consumers. Any point on the contract curve is, therefore, Pareto efficient. On any point of the contract curve, the first condition of Pareto efficiency is fulfilled. This is given as

$$MRS_{YX}^A = MRS_{YX}^B$$

That is the marginal rate of substitution between the two goods must be equal for all. From any point on the curve, it is not possible to improve the welfare of one without making the other worse off. But off the contract curve, we can make Pareto improvements. For example, from S to Q consumer B's welfare has improved and A's welfare is the same.

Pareto efficiency can also be illustrated in production. Suppose that we can produce two goods, X and Y using two inputs; capital and labour (K, L). These two inputs are allocated to the production of the outputs according to  $(K^x, L^x)$  and  $(K^y, L^y)$  where the initial endowment factors are given

$$K = K_x + K_y$$

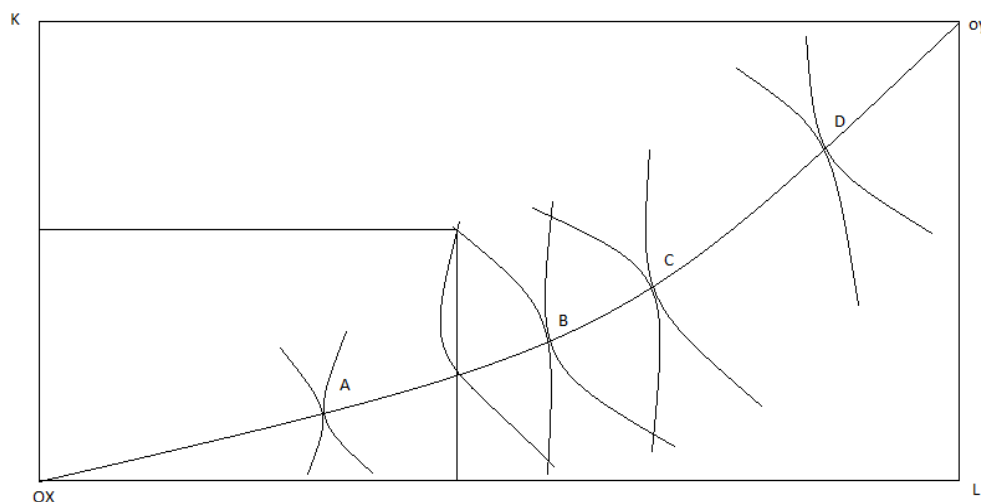
$$L = L_x + L_y$$

While the output derived from these inputs are given by the production technologies

$$X = X(K^x, L^x)$$

$$Y = Y(K^y, L^y)$$

For the production of two goods to be Pareto efficient, we cannot reallocate inputs between the two goods such that more of one is produced without reducing some of the other output. Technical efficiency under Pareto efficiency requires that the technical rate of substitution between any pair of productive factors be equal across different producers. This can only occur if we produce on the production possibility frontier. The Edgeworth box of production in Fig 2.2 illustrates Pareto-Efficiency in production.



**Fig. 2.2: Pareto-Efficiency in production**

Only points on the contract curve are Pareto-efficient Point H is inefficient since a reallocation of K and L between producers of X and Y to reach any point from B to D inclusive results in the increase in at least one commodity without a reduction in the other. The contract curve is the locus of tangency of the isoquants of the two producers where the slopes of the isoquants are equal. It is at this point on the contract curve that the following condition holds:

$$\text{MRTS}_{LK}^X = \text{MRTS}_{LK}^Y$$

This is the Pareto – efficiency condition in production.

### 2.2.1.2 Technical and allocative efficiency

Economic efficiency has both technical and allocative components. The technical components refers to the ability to avoid waste either by producing as much output as technology and input usage allow or by using as little input as required by technology and output production. Koopmans (1951) provides what is termed as the formal definition of technical efficiency. He defines technical efficiency as “an input-output vector is technically efficient if and only if increasing any output or decreasing any input is possible by decreasing some other output or increasing some other input.” In other words, a producer can be described as technically efficient if an increase in any output requires a reduction in at least one other output or an increase in at least one other input.

From the above, it is possible for a technically inefficient producer to use less of at least one input to produce the same output or produce more of at least one output using the same inputs. Technical efficiency can, therefore, be described as the ability of the firm to produce on the production frontier. Farrell (1951) improved upon the

work done by Koopmans stating that production efficiency has another component that reflects the ability of producers to choose the exact technically efficient input-output vector in light of the prevailing input and output prices. Farrell, therefore, defines efficiency as a product of technical and allocative efficiency (Farrell 1951). Technical efficiency can, therefore be described as the ability of the firm to produce on the production frontier.

The allocative component of productive efficiency emphasizes the prices of inputs and output. This is why Farrell termed it as “price efficiency”. This allocative component refers to the ability to combine inputs and/or outputs in optimal proportions in light of prevailing prices (Farrell 1951). Allocative efficiency therefore can be distinguished from technical efficiency. While the former measures a firm’s success in selecting an optimal set of inputs with a given set of input prices, the later can be associated with the production frontier, which measures the firm’s ability to produce maximum output from a given set of inputs.

### **2.2.1.3 Structural efficiency**

According to Farrell (1957), structural efficiency measures the extent to which an industry keeps up with the performances of its own best firms. It is a measure at the industry level of the extent to which its firms are of optimum size i.e. the extent to which industry production level is optimally allocated between the firms in the short run, and the extent to which high cost firms are eliminated. Structural efficiency shows the extent to which the industry production level is optimally allocated between the firms in the short run. By implication, industry or cluster A is more efficient structurally than industry B if the distribution of its best firms is more concentrated

near its efficient frontier for industry A than B. Bjurek et al (1990) compute structural efficiency by simply constructing an average unit for the whole cluster and then estimating the individual measure of the average unit.

#### **2.2.1.4 Scale efficiency**

This is the type of efficiency that occurs when an industry exhibits returns to scale. Scale efficiency is used to determine how close an observed firm is to the most productive scale size (Banker and Thrall, 1992). A firm may be scale inefficient if it exceeds the most productive scale size and hence experiences decreasing returns to scale. If the firm is smaller than the most productive scale size, then it is failing to take full advantage of increasing returns to scale and hence also inefficient. The firm under study may also exhibit economies of scope. Scope efficiency relates to benefits realized by firms that produce several product lines compared to specialized enterprises. This aspect of economic efficiency is of particular interest in agriculture since there are many debates on optimal production structure of agricultural enterprises. An empirical measurement of farms' scope efficiency was proposed by Chavas and Aliber (1993). They measured scope efficiency as the relative cost of producing livestock and crops separately compared to their joint production.

### **2.2.2 Measurement of efficiency**

#### **2.2.2.1 An Overview**

Productive efficiency has been analysed since 1766 with the publication of Adam Smith's classic book "An Inquiry into the Nature and Causes of Wealth of Nations". In his book, Adam Smith discusses how the invisible hand consisting of market forces of demand and supply will achieve the most efficient level of production,

consumption and distribution of goods in the society. However, serious analytical approach to the measurement of efficiency in production originated only with the work of Koopmans (1951), Debreu (1951) and empirically applied by Farrell (1957).

Shephard also made a significant contribution to the analysis, measurement and development of efficiency and productivity through his models of technology and his distance functions (Shephard 1953, 1970, 1974). Direct input and output correspondences allow multiple outputs and multiple inputs unlike the traditional production function. One very important useful property of Shephard's distance function is that is the fact that the reciprocal of the direct input distance function was proposed by Debreu (1951) as a coefficient of resource utilization, and by Farrell (1957) as a measure of technical efficiency. This property has both a theoretical and a practical significance. It allows the direct input distance function to serve two important roles, simultaneously. It provides a complete characterization of the structure of multi-input, multi-output efficient production technology, and a reciprocal measure of the distance from each producer to that efficient technology ([www.springer.com](http://www.springer.com)).

Charnes and Cooper (1961) contributed significantly to the development of linear programming. In the late 70's, they actually popularized its application in Data Envelopment Analysis (DEA) in the late 70's (Charnes, Cooper and Rhodes, 1978). Forsund and Sarafoglou (2002) offer an interesting historical reconstruction of the literature developments subsequent to Farrell's seminal paper that lead to the introduction of the DEA methodology ([www.springer.com](http://www.springer.com)).

In these models observed activities, such as the inputs and outputs of some production units, serve as coefficients of activity or intensity variables forming a series of linear inequalities, yielding a piecewise linear frontier technology. The work of Koopmans and Shephard imposes convexity on the reference technology; therefore, the DEA estimator relies on the convexity assumption.

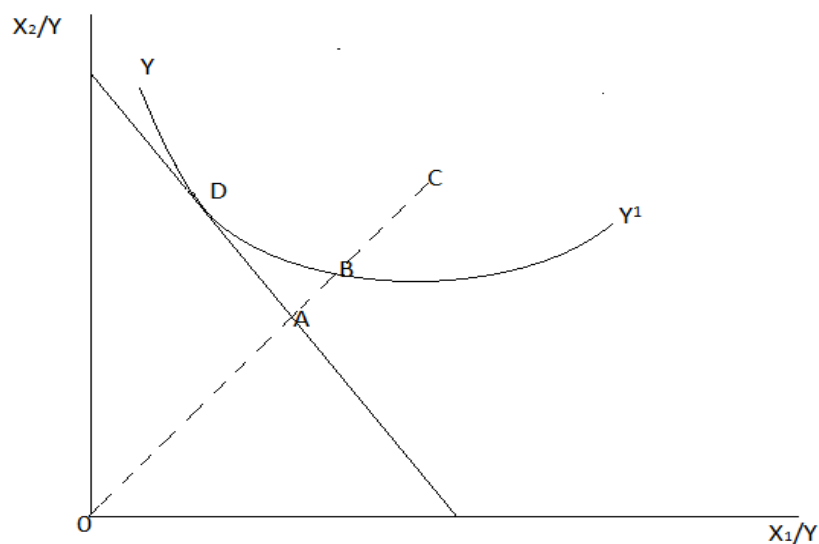
The Free Disposal Hull (FDH) estimator, that maintains free disposability while relaxes convexity, was introduced by Deprins, Simar and Tulkens (1984). By enveloping data points with linear segments, the programming approach reveals the structure of frontier technology without imposing a specific functional form on either technology or deviations from it ([www.springer.com](http://www.springer.com)).

Debreu (1951) and Farrell (1957) noted that a production unit is efficient as long as it operates on the production frontier, but not necessarily by the Koopmans (1951) definition of technical efficiency. Koopmans (1951) definitions of technical efficiency have often been criticized as not being efficient, since in order to increase output another output associated with it must necessarily be decreased. Similarly, Kalirajan and Shand (1999) proposed that firm's performances are measured based on their efficiency levels which are made up of the two distinct components proposed by Farrell (1957) namely; technical and allocative efficiency. Ellis (1988) further defines technical efficiency as the maximum possible level of output attainable from a given set of inputs, given a range of alternative technologies available.

Frontier technology provides a simple means of computing the distance to the frontier - as a maximum feasible radial contraction or expansion of an observed activity. This means of measuring the distance to the frontier yields an interpretation of performance or efficiency as maximal-minimal proportionate feasible changes in an

activity given technology. This explanation is consistent with Debreu's (1951) coefficient of resource utilization and with Farrell's (1957) efficiency measures. However, neither Debreu nor Farrell formulated the efficiency measurement problem as a linear programming problem, even though Farrell and Fieldhouse (1962) envisaged the role of linear programming. The full development of linear programming techniques took place later.

The origin of the modern discussion of efficiency measurement, therefore, dates back to Farrell (1957). He identified two ways by which productive agents can be inefficient i.e. an agent can use more inputs than technically required to obtain a given level of output, or an agent can use a sub-optimal input combination given the input prices and their marginal productivities (Santiago et al 2005). The former is termed technical inefficiency while the latter is allocative inefficiency. We can represent these two types of inefficiency in the figure below:



**Fig. 2.3:** Technical and allocative efficiency

From the figure above, the set of minimum inputs required for a unit of output lies on the isoquant curve  $yy^1$ . Bundle C, which is an input-output combination produces one unit of output quantities  $X_1$  and  $X_2$ . The segment BC represents the inefficiency in resource utilisation since the same output can be produced by using less of both inputs back to B. The technical inefficiency is therefore given as  $TE=OB/OC$ . The allocative efficiency is given as  $AE= OA/OB$  since the least cost combination of inputs that gives one unit of output is given by point D.

Over the past decades, various techniques have been developed to estimate the unknown and unobservable efficient frontier (in the case of the isoquant  $yy^1$ ). These methods have been categorised into parametric and non-parametric methods. Each of these methods estimates efficiency as the distance from the observed input-output combination to an efficient frontier. The frontier refers to the maximum attainable output for a given level of input (Santiago et al, 2005).

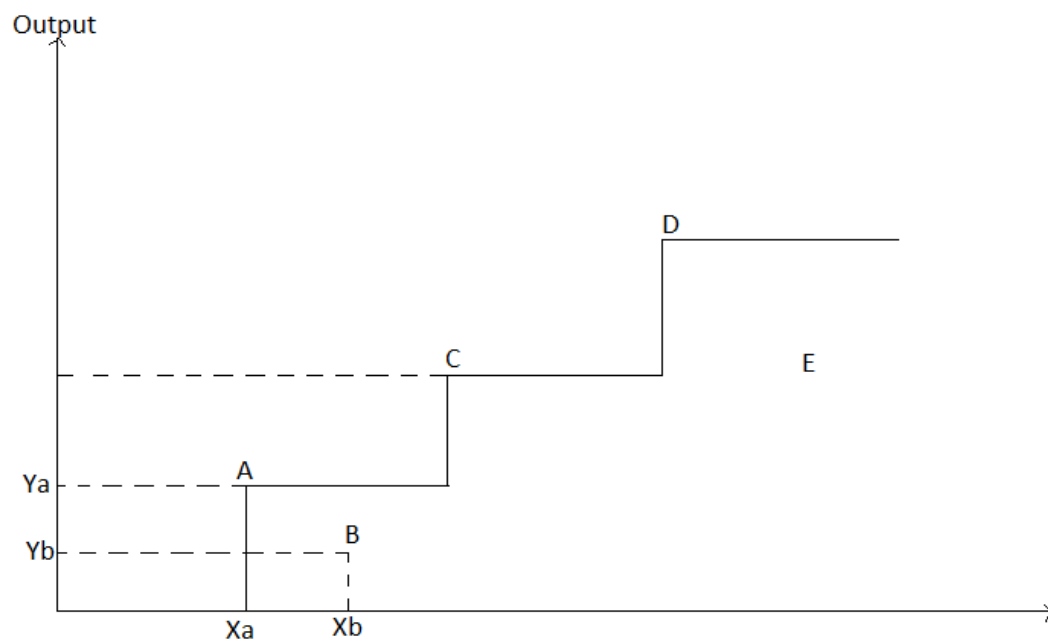
#### **2.2.2.2 Non-parametric methods**

Non-parametric methods do not assume specific functional forms for the relationship between inputs and outputs or for the inefficiency terms. These methods use mathematical programming techniques. Examples of these methods are Free Disposable Hull (FDH) and Data Development Analysis (DEA).

##### **2.2.2.2.1 The Free Disposable Hull (FDH)**

The FDH analysis method has been developed to empirically estimate the relative efficiency of production units. The concept used in FDH analysis is based on X-inefficiency (Leibenstein, 1966) i.e. a producer is relatively inefficient if another

producer uses less or an equal amount of inputs to generate more or as much output. First of all, the production possibility frontier representing combination of best observed results among the sample of observation is established. Then, we measure the relative inefficiency of producers inside the production possibility frontier by the distance from the frontier. FDH assume free disposability of resources. Figure 3.2 illustrates the FDH Possibility Frontier



**Fig. 2.4:** FDH production possibility frontier

From figure 2.4 above, two countries, A and B produce outputs  $Y_A$  and  $Y_B$  using input  $X_A$  and  $X_B$  respectively. The input efficiency score for country B is given as  $X_A/X_B$ . The output efficiency score is defined by the quotient  $Y_B/Y_A$ . A score of 1 implies the country is on the frontier.

An input efficiency score of 0.80 implies that this particular country uses inputs in excess of the most efficient producer to achieve the same output level. An output efficiency score of 0.80 implies that the inefficient producer obtains 80% of the output attained by the most efficient producer with the same output intake. Therefore, a producer is relatively efficient if there is no producer that uses less or an equal

quantity of inputs to generate as much or more output. The FDH, therefore, provides a tool to identify best practices in government spending and assess how governments are faring in comparison with these best practices (Gupta 1999).

#### **2.2.2.2.2 Data Envelopment Analysis (DEA)**

The Data Envelopment Analysis (DEA) is a non-parametric technique developed by Charnes, Cooper and Rhodes (1978). DEA is used to differentiate between efficient and inefficient organisations. It is a non-parametric programming technique that computes a comparative ratio of outputs to inputs for each decision making unit (DMU). This is reported as the efficiency score. Best practice units are given a rating of one and efficiency scores are assigned to other units by comparing them with best practice units. The larger the sample, the more precisely will be the result. This implies that in order to avoid large variances, a large quantity of data is needed. This means that in principle, the DEA procedure constructs a piecewise linear quasi-convex hull around data points in the input space (Greene 2005)

The main problem of the DEA is that there is no provision for statistical noise or measurement error in the model. There is also the absence of a definable set of statistical properties. However, the DEA tool has become accepted as a management tool in performing efficiency analysis. Charnes et al (1978) describes the DEA methodology as a mathematical programming model applied to the observed data that provides a new way of obtaining empirical estimates of extreme relations such as the production surfaces that are the cornerstones of modern economics. Between 1978 and 1992, over 400 articles, books and dissertation involving DEA were published

(Charnes et al, 1997). This is an endorsement of the increasing popularity of this approach.

One advantage of the DEA is that it avoids the problem of misspecification of functional form. However, this approach does not take care of data noise and inefficiency. It also has dimensionality problems. Finally, empirical application of these models is difficult due to rigorous data requirements. That is information on the expected values of all variables, variance-covariance matrix for all variables and probability levels at which feasibility constraints are to be satisfied (Lovell, 1993).

### **2.2.2.3 The Parametric or Stochastic Frontier Models**

The parametric or stochastic frontier analysis comprises of a production function with a composite disturbance term which has two components. One error component represents the effects of statistical noise while the other captures the systematic influences that are unexplained by the production function also known as technical inefficiency. The major advantage of the stochastic frontier analysis is the introduction of the disturbance term representing noise and the inefficiency component. This property of the stochastic frontier model makes it appropriate for the measurement of the efficiency of government spending.

The estimation of parametric production function takes its root from the work by Aigner and Chu (1968), Afriat (1972) and Richmond (1974). They assume a function that gives the maximum possible output as a function of inputs, i.e.  $Y_i = f(X_i; \beta)$

Where

$Y_i$  = the maximum output obtainable by the  $i$ th firm.

$X_i$  = a vector of non-stochastic inputs.

$\beta$  = unknown parameter vector to be estimated

According to Aigner and Chu (1968),  $\beta$  can be estimated by mathematical programming methods based on a cross-section of N firms within a given industry.

They suggest the minimization of

$$\sum_{i=1}^N |Y_i - f(X_i, \beta)| \text{ Subject to } Y_i \leq f(X_i, \beta)$$

The disturbance term is implicitly assumed. In order to give a statistical basis, Schmidt (1976) adds a one sided disturbance term that yields the model.

$$Y = f(X_i; \beta) + \varepsilon_i$$

$$\varepsilon_i \leq 0$$

With the specified disturbance term the model can now be estimated using maximum likelihood technique. The model that serves as a foundation of other variation was developed by Aigner, Lovell and Schmidt (1977). This model is given as

$$Y = \beta^1 X + v - u$$

Y = observed outcome

$\beta^1 + V$  = optimal frontier goal (eg. Maximum production output or minimum cost).

$\beta^1 X$  = deterministic part of the frontier

The production model is based on a Cobb-Douglas, translog or other forms of logarithmic model. This can be re-written as

$$\text{Log} Y = \beta^1 X + v - u$$

Log X = logs of inputs for a production model. Here U represents the proportion by which Y falls short of the target or the percentage inefficiency. A detail of the model is discussed in the next chapter.

### **2.3 Empirical review**

There is abundant literature on the measurement of productive efficiency of various sectors and units. For example, we have papers measuring efficiency of small scale rice farmers in Nigeria (Shehu, 2007), electric generation plants, banks (Wheelock and Wilson 2003), schools and many others. However, few papers have measured public sector efficiency using cross country data. Most of these studies employ both parametric and non-parametric techniques to analyse the efficiency of government spending in various parts of the world. The most common technique employed in most papers is the Data Envelopment Analysis (DEA). Few of these papers have applied the Free Disposable Hull approach while a handful of researchers have attempted employing the stochastic frontier analysis for measuring efficiency. One contribution of this study is, therefore, the use of the Stochastic Frontier Analysis (SFA) to analyse the efficiency of government spending in the ECOWAS sub - region.

There are two kinds of existing academic literature that are related to the analysis of this paper. One kind of literature examines the relationship between health and education outcomes and the expenditure directed towards them. Some find some positive relationship others do not find any relationship between the two. The other kind of literature investigates the efficiency of countries in achieving outcomes and also examines their determinants.

### **2.3.1 Literature on the link between Health and Education Expenditures and Outcomes**

In recent years, a growing number of studies have tried to examine the relationship between health expenditure and health outcomes, especially its impact on under-five mortality and infant mortality. So far, available literature documents a range of effects. Some discover no impact, others find limited impacts, and the rest find impacts on only specific interventions. Early studies (as summarized by Musgrove in 1996) do not find any evidence that total spending on health has any effect on child mortality.

Filmer and Pritchett (1997) present empirical evidence that suggests that public spending on health is not the dominant determinant of child mortality outcomes. They discover that female education, income, income inequality and “cultural factors” such as the degree of ethno linguistic fractionalization explain practically better most of the variation in child mortality across countries. These findings, therefore suggest that countries should pursue policies that would increase female education, encourage economic growth, reduce poverty and income inequality, in order to contribute more to reducing child mortality rather than just increasing government spending on health. Other researchers like Musgrove (1996) and Kim and Moody (1992) also discover similar findings of lack of significance of public health expenditure.

Filmer and Pritchett (1999), using cross-national data, explore the impact of public health spending and other factors on child and infant mortality. They specify a multivariate regression that includes variables like income, public health spending and other socioeconomic factors. Their findings show that government health spending accounts for less than one-seventh of one percent variation in under-five mortality

across countries, though the result was not statistically significant. They conclude that factors such as a country's per capita income, female educational attainment, and choice of region explain about 95 percent of the variation in under-five mortality.

Or (2001) conducts a research on the determinants of variations in mortality rates over 21 OECD countries using a panel data ranging from 1970 and 1995. His result shows that per capita health spending has a weak impact on health outcomes. According to the author, the absence of a strong statistical relationship may be as a result of model misspecification or may reflect the fact that at high levels of population, the returns to increases in health spending are small.

Berger and Messer (2002) examine the impact of public health expenditure, insurance coverage and other factors on health outcomes within health production models in 20 OECD countries estimated using a panel data from 1960 to 1992. Their result show that health care expenditures and the type of health insurance coverage implemented determines mortality rates. In particular, increases in the publicly financed share of health expenditures are associated with increases in mortality rates. The authors, therefore, conclude that, as countries increase the level of their health expenditures, they may want to avoid increasing the proportion of their expenditures that are publicly financed.

Gupta et al. (2002) use OLS and Two Stage Least Squares (2SLS) to determine the overall level of public spending and intra-sectoral allocation in a cross-sectional study of 50 developing countries. They use educational outcomes like enrolment rates in primary and secondary school, persistence through Grade 4, and primary school drop-out rates. The 2SLS technique is used primarily to address the problem of reverse causality. For instance, higher spending on primary education may have a positive

effect on enrolment, but a higher demand for primary education, reflected in higher enrolment rates may also lead to a push for higher spending. Most spending and other data are for 1993-1994; the expenditure data, in general, exclude local government spending. Overall, the authors find that increased public spending on education and health care is positively correlated with educational attainment and health status, with the evidence being stronger for education. The authors further note that other socio-economic variables, such as urbanization and per capita incomes, are important determinants of educational attainment.

Wagstaff and Cleason (2004) employ a model that is similar to that of Filmer and Pritchett (1997, 1999). They demonstrate that good policies and institutions (which is measured by the World Bank's Country Policy and Institutional Assessment or CPIA index), are more important in explaining the impact of government health spending on health outcomes. The results indicate that the impact of government health expenditures on maternal mortality, underweight children, under-five and tuberculosis mortality increases as the quality of policies and institutions improves (i.e. as the CPIA index rises), and is statistically significant. However, in their conclusion they indicate that the impact of government expenditures on under-five mortality remains not significantly different from zero.

A World Bank report (2004) includes a study on the analysis of infant mortality and health expenditure for some Indian states using a panel data during 1980-99. This study does not find any impact of health expenditure on mortality rates once state fixed effects and a linear time trend are included in the model. On the contrary, using data for 50 developing and transition countries observed in 1994, Gupta et al (1999), find that increases in health expenditure reduces childhood mortality rates.

Using panel data from 118 developing countries in 1971–2000, Baldacci et al. (2008) estimate a non-linear model to capture relationship between spending and outcomes in education. They account for the interaction between education and health, and control for governance and the higher growth attributable to better human capital and country income levels. The fixed-effects model is utilized to make the most out of limited cross-country time series data, and minimize distortions from heterogeneity. Baldacci et al. find strong evidence that public expenditure on education directly results in increased better educational outcomes. However, the positive effects of education spending are reduced in countries suffering from poor governance. The authors further find that higher spending alone is insufficient; other policy interventions, such as improving governance and curbing inflation, must be incorporated to achieve the MDGs.

However, these results should be interpreted with caution given the wide variety of country circumstances and nonlinearity in the effects of public expenditure. Specifically, health and education spending would impact regions with different needs in non-homogenous ways. The authors conclude that additional research is needed to assess the impact of different components of social expenditure. According to the authors, increasing education spending by 1 percent of GDP would raise enrolment rates by 6 percentage points.

In a related study, Rajkumar and Swaroop (2008) empirically examine whether public expenditure on education is more effective in improving educational outcomes in countries with good governance. Their education results are based on a sample that has 101 observations from 57 countries using annual data for 1990, 1997 and 2003. The authors capture the direct effects of governance on educational outcomes by using the governance variable, as an independent regressor, and the indirect effects of

governance by interacting  $G_i$  with the share of public primary education spending in GDP. They use OLS and 2SLS to estimate the impact of spending on outcomes such as the primary school completion rate, and control for the level of corruption, and the bureaucratic quality of the government. In their regressions, the coefficient on primary education spending becomes significant only when the interaction term between spending and good governance is included. Thus, as the level of corruption falls or the quality of the bureaucracy rises, public spending on primary education becomes more effective in achieving primary education attainment.

Yaqub et al (2012) investigates the relationship between public health expenditure and health outcomes in Nigeria. They employ both the ordinary least squares (OLS) and the two stage least squares (2SLS) technique. The 2SLS is used because of the possibility of reverse causality of health outcome and public health spending. They regress public health spending and governance (measured by the corruption perception index) on infant mortality and life expectancy. They employ panel data from 1980 to 2008. The results obtained show a negative relationship between public expenditure and health outcomes when governance is included as explanatory variable. The policy implication is that Nigeria can only achieve the Millennium Development Goals in the health sector (i.e. raising life expectancy, lowering under-five mortality rate by two-thirds and reducing infant mortality rate) if the level of corruption is reduced considerably.

Savas and Okan (2013) explore the effect of government health spending on health outcomes using cross-sectional regressions. They specify a model that estimates the relationship between child and infant mortality rate and public health spending in a worldwide sample. Results indicate a negative relationship between government

health spending as a share of GDP and lower level of under-5 mortality by elasticities of from -0.17 to -0.22, with elasticity of -0.20 for infant mortality. When government spending as a share of total health expenditures is used as an estimator, elasticities are -0.33 for under-5 mortality and -0.22 for infant mortality. Findings also show that, education level, population and income level are the main determinants. The results imply that a percentage increase in government health spending as a share of GDP is associated with a 20% decrease in infant mortality.

In addition, many other other studies have not been able to find any strong and consistent link between public health spending and health outcomes (after controlling for other factors). On the contrary, socio-economic factors are often found to be determinants of health outcomes. Burnside and Dollar (1998) find no significant relationship between health expenditure spending and the change in infant mortality in low-income countries.

Kim and Shanon (2013) seek to investigate the relationship between public health expenditure and national health outcomes among developed countries including Germany, France, Canada, Italy, Japan and Finland. They employ panel data from 17 OECD countries between 1973 and 2000. They use infant mortality rate and life expectancy at birth as dependent variables. In addition to public health spending, other socioeconomic factors like real GDP per capita, the Gini coefficient, unemployment rates, are included as independent variables. To analyze the cross-country panel data, the study employed a mixed-effect model. The study finds a statistically significant relationship between government health expenditure and public health outcomes. Particularly, the findings showed a negative relationship between government health expenditure and infant mortality rate, and a positive

relationship between government health expenditure and life expectancy at birth. The results suggest that higher government spending on medical goods and services can be shown to provide better overall health results for individuals.

The Keynesian framework in economic theory suggests a positive relationship between government spending and output and hence, one would expect educational expenditures to be associated with better educational outcomes such as higher enrolment rates and increased school completion. Spending more on teachers, buildings, textbooks, and other such materials should provide students with better quality facilities and learning opportunities. However, empirical research has debated the question of whether education expenditures do improve educational outcomes.

In a comprehensive global survey of the literature on the determinants of educational outcomes, Roberts (2003) finds that while developing countries need to commit more resources to primary education, they need to simultaneously improve efficiency in delivery and educational quality.

Although developing countries have been spending more (relative to GDP) since 1970 on education, Roberts notes that expenditure levels bear no strong relationship to primary school enrolment and completion rates. Increasing public investment alone does not seem to be enough to improve the quantity and quality of primary education. Based on a study of 37 African countries from 1984-1995, Gupta and Verhoeven (2001) find similar results that the effectiveness of service delivery is more important than the quantum of public spending. Higher spending on education and health does not necessarily improve social outcomes unless the efficiency of government spending is improved. These efficiencies arise due to relatively high government wages (in the case of education) and non-optimal intra-sectoral allocation of

resources. For example, many countries spend far too much on teacher salaries and not enough on teaching materials, educational facilities, and other crucial inputs. Reducing the student-teacher ratio does not significantly improve education attainment either.

Most of the studies mentioned above use cross-country datasets for their analysis. At the state level, Kaur and Misra (2003) have done a similar empirical analysis for fifteen states in India. They analyse the impact of public expenditure on primary and intermediate, and secondary school enrolment rates, controlling for variables such as the level of economic development and quantity of physical infrastructure in a state. Their panel regression results from 1985-86 and 2000-01 indicate that public expenditure on education has been generally productive, especially in poorer states. In terms of outcomes, public expenditure has a greater effect on primary education than secondary education. The role of public funding decreases at higher stages of education. The authors speculate that one of the reasons for this could be that private funding plays a greater role.

### **2.3.2 Empirical literature on the efficiency of government expenditure**

The few papers that attempt researching into the efficiency of government expenditure discovers varying degree of results depending on time, space and methodology employed.

Grupta et al (1997) assess the efficiency of government spending on health and education in 38 countries in Africa in 1984-1995 both in relation to each other and compared with countries in Asia and the Western Hemisphere. This paper employs the FDH technique. Health output is measured by life expectancy, infant mortality and

immunisation against measles and diphtheria-pertussis-tetanus (DPT) and education attainment by primary school enrolment, secondary enrolment and adult illiteracy. Results indicate that health and education spending in the Gambia, Guinea, Ethiopia and Lesotho is associated with relatively high educational attainment and health output. The opposite occurs in Botswana, Cameroon, Cote d'Ivoire and Kenya. In addition, governments in African countries are less efficient in the provision of health and education services than the countries in Asia and the western hemisphere. Results also show that inefficiencies in Africa are not related to private spending but may be due to high government wages and intra-sectoral allocation of government resources. Finally, results show no relationship between input efficiency scores and public spending as a share of GDP.

Evans and Tondon (2000) adopt a parametric technique to examine the efficiency of national health systems for WHO. They estimate fixed effects panel of 191 countries for the period 1993-1997. These include both developed and developing countries. Health output is measured by the Disability Adjusted Life Expectancy (DALE) index while health expenditures and average years of schooling of adult population are considered as inputs. They also included the square of inputs i.e. health expenditures and average years of schooling. The output efficiency score is defined as the ratio of actual performance above the potential maximum. They also construct confidence interval for the efficiency estimates through a Monte-Carlo procedure. Results indicate a positive relationship between their efficiency scores and level of spending. The efficient health systems are those of Oman, Chile and Costa Rica while the inefficient ones are all African, i.e. Zambia, Namibia, Botswana, Malawi, Zimbabwe and Lesotho.

Jarasuriya and Woodon (2002) employ a parametric technique to examine the efficiency of health and education expenditures in 76 developing countries. They use a panel of 76 countries covering the period 1990-1998. In stage one, they employ the Stochastic Frontier Analysis using per capita expenditures on health and education, the level of GDP per capita, the adult literacy rate, a time trend as input variables. Their output variables are life expectancy and net primary enrolments. In a second stage, they investigate the determinants of efficiency using measures of corruption, bureaucratic quality and urbanisation. Results show that urbanisation and bureaucratic quality are most important determinants of efficiency of health and education expenditures.

Greene (2003) builds on the work done by Evans and Tandon (2000) and other researches on the measurement of national health systems for the World Health Organisation using a five year panel for a sample of 191 countries worldwide. His main criticism of other researches using the same data is that previous studies did not make provision for heterogeneity in their methodology and hence evidence of heterogeneity were considered as inefficiency. Greene therefore applies a more general and flexible stochastic model in which several indicators of cross-country heterogeneity are added to the previous researchers. His model also allows for time variation of the coefficients. Several variables that provide indicators of cross-country and time-wise heterogeneity are included. These include Gini coefficient, Voice (World Bank measure of democratization) Dummy for tropical location and population density.

Santiago and Gaobo (2005) employ both the Free Disposable Hull (FDH) and the Data Envelopment Analysis (DEA) techniques to examine the efficiency of

government expenditures and health sectors in a sample 140 countries using data from 1996 to 2002. Countries in which higher wage bill represents a higher fraction of total expenditure tend to be more inefficient. Similarly, countries with higher ratios of public to private financing of service provision score lower efficiency scores. The same result applied to countries plagued by HIV/AIDS epidemic and those with higher income inequality. Countries with higher aid-dependency ratios also tend to score lower in efficiency. It is worth noting that none of the institutional variables proved to be statistically significant. The reason given for this development is data limitation. For instance, corruption index was very limited. This index, however, can be significant in this study since data has been extended to 2012.

Simon and Rogers (2008) examine the efficiency of government expenditures and foreign aid in Small Island Development States (SIDS). Efficiency is estimated using a Stochastic Production Frontier Approach and panel data from 1990 to 2004. This paper uses life expectancy as an outcome for health and gross primary and secondary school enrolment (with an equal weighting) as a measure for educational achievements. Results indicate that GDP per capita, urbanisation and population density are positively associated with life expectancy while tropical area, and the level of ethnic fractionalisation are negatively associated with life expectancy. There is no evidence that health expenditures or foreign aid are associated with levels of life expectancy. Results also suggest that school enrolments are positively associated with GDP per capita, the level of public sector education expenditures, urbanisation and population density, and negatively associated with tropical area and ethnic fractionalisation. Interestingly, the level of education expenditures appears important for school enrolments even though the level of health expenditures does not appear to

explain life expectancy. Furthermore, government and literacy appear important for public sector efficiency.

Wang and Eskander (2010) used data from 1986 to 2007 for OECD and Asian countries to investigate the relative efficiency of government spending and its determinants. They employed the DEA technique to examine the technical efficiency of using government spending in raising the GDP in these countries. Key findings suggest that government spending inefficiency declines when complimented by an increase in private economic activities especially investment consumption and exports. Also monetary expansion worsens government's ability in promoting GDP.

Danquah et al (2013) examine the determination of national efficiency in Sub-Saharan African countries over the period 1970-2010. They employ a variant of a complex time 'decay' specification of the stochastic frontier model. In this model, the inefficiency effects are assumed to be non-monotonic, and hence for the control of the time invariant random components in the specification. They find that trade policy openness, machinery imports, stock of R&D, landlockness, quality institutions play a significant role in explaining these differences in efficiency scores in SSA. Findings suggest that the relatively efficient countries are open to trade, have democratic regimes, relatively good quality institutions and are located in the tropics.

A current research carried out on the efficiency of government is the Alfonso, Romero and Monslave (2013). This study was done for Latin America. They compute Public Sector Performance (PSP) and Public Sector Efficiency (PSE) and Data Envelopment Efficiency scores for a sample of twenty three Latin American and Caribbean countries to measure efficiency for the period 2001 to 2010. The major findings are that public sector efficiency is inversely correlated with the size of the government.

That is 100% of small governments are ranked as more efficient according to PSE scores against 50% and 13% of medium and large governments. In addition, more transparency, regulatory corruption and property right improve efficiency scores.

The empirical review brings to the fore a lot of gaps in literature. These gaps are in terms of methodology, scope and time. The latest work on the efficiency of government expenditure in education and health in Africa dates as far back as 2004. This study contributes to literature by extending data to 2011. In addition, most studies on the efficiency of government expenditure employ the non-parametric approach. This informs our decision to employ the stochastic frontier analysis and also apply the Battese and Coelli model. Finally, none of these studies have been done for the ECOWAS sub-region as far as we are concerned.

## **CHAPTER THREE**

### **OVERVIEW OF GOVERNMENT EXPENDITURE AND OUTCOMES**

#### **3.1 Introduction**

This chapter presents a general overview of government spending and its outcomes in education and health sectors of countries in the ECOWAS sub-region. The chapter touches on the history of ECOWAS, various outcomes and expenditure levels in education and health in the sub-region.

#### **3.2 A brief history of ECOWAS**

The Economic Community of West African States was established in 1975. Prior to its formal establishment, several events preceded the signing of the agreement. The idea to create a West African Community was developed by Former Liberian President William Tubman. His idea led to the signing of an agreement between Cote d'Ivoire, Liberia, Guinea and Sierra Leone in February, 1965. This agreement was just a formality and not an actual call to action.

General Gowon of Nigeria and General Eyadema of Togo reintroduced the idea in 1972. These two generals drafted a proposal and they went to twelve West African countries to elicit support and assess interest. On May 1975, 15 West African countries finally met in Lagos, Nigeria and signed the ECOWAS treaty also known as the treaty of Lagos. The 15 countries were Ghana, Burkina Faso, Gambia, Sierra Leone, Niger, Nigeria, Mauritania, Benin, Guinea Bissau, Liberia, Senegal, Togo, Guinea and Cote D'Ivoire. The ECOWAS Treaty created the Economic Community of West African States. The main purpose of this treaty was to promote cooperation and integration within West Africa and to eventually establish an economic and monetary union. In 1977, Cape Verde became the sixteenth member of the ECOWAS.

In 1993 the member states signed a revised treaty. The revised treaty outlined the necessary steps to be taken for the establishment of a common market and currency. This revised treaty also established a West African Parliament, an Economic and social council and a Court of Justice. In 1999, a summit was held where Mauritania withdrew from the ECOWAS as a result of conflicting opinions on some of the decisions made during the summit. This reduced the number of members to 15.

Since the establishment of the ECOWAS up till now, there have been various agreements signed just to make the sub-region united and economically viable. These agreements are centred on four main pillars; peace and security, developing infrastructure, policy harmonisation to facilitate trade and good corporate governance.

### **3.2.1 Outcomes of health delivery in the sub-region.**

For the past decades, Africa and for that matter, the ECOWAS sub-region have seen the life expectancy of its population reduced by communicable and parasitical diseases that have mostly been eliminated in the developed countries. The sub-region is also experiencing increasing rates of the non-communicable lifestyle diseases which have become killers in the developed nations. Many countries in the sub-region are still not able to provide basic necessities of life such as proper sanitation, potable and safe water, and adequate balanced diet to their citizens. Member states are also saddled with high infrastructural deficits, inadequate and ill trained skilled human resources, tribal, regional and ethnic conflicts, political instability and corruption among others. These problems have hindered the development of the two most central sectors necessary for growth and development. The success and growth of every economy largely depends and the levels of literacy and health standards of the larger

population. However countries within the ECOWAS sub-region are confronted with this daunting challenge of high illiteracy and poor health care delivery services.

Health care delivery in the sub-region is hampered by several issues. Countries in the sub-region generally range from those that are resource rich to impoverished, and from those with dynamic economies to those with conflict zones. They include large cities and very remote villages and nomadic lands with unmotorable roads that make access to good health care a challenge. Countries in sub-region also continue to struggle with communicable diseases such as HIV/AIDS, TB, and Hepatitis B. According to the World Health Organization (WHO), Africa bears sixty six percent (66%) of the global burden of HIV/AIDS. Unfortunately just one third of the population with advanced HIV infection had access to antiretroviral medicines in 2007.

It is important to note that the social health indicators that serve as outcomes for health expenditures have not been encouraging in the ECOWAS sub-region. In 2000, UN Millennium declaration was agreed in 189 countries. Both rich and poor countries expressed their unprecedented commitment to attain improvements in human development by the year 2015. This commitment is summarized in the Millennium Development Goals (MDGs) that set targets in areas of poverty reduction, health improvements, education attainment, and environmental sustainability among others.

Under-five child mortality, the probability of dying between birth and age five years expressed per 1000 live births, and infant mortality (IMR), i.e. the probability of dying before age one expressed per 1000 live births have always been used as a measure of child's well-being. Infant mortality is regarded as a sensitive indicator

of availability, utilisation and effectiveness of health care and it is commonly used to compare healthcare systems.

In 2011, the world's average was 51 (5.1%) down from 87 (8.7%) in 1990. The average was 7 in developed countries and 57 in developing countries including 109 in sub-Saharan Africa. Countries in the ECOWAS sub-region recorded some of the highest rates. For example, Guinea Bissau had 193(19.3%), Sierra Leone 192(19.2%), Mali 191 and Burkina Faso 166 and Nigeria 91.

Life expectancy refers to the average number of years a person born in a given country would live if mortality rates in a given country were to remain constant in the future. Life expectancy in a country reflects the quality of health care in that country and it is a very important indicator of health outcomes. According to the WHO, as at 2013, the world's average was 71.0 years. Out of the thirteen countries noted as having the lowest overall life expectancies worldwide three are from West Africa alone. They include Guinea Bissau (50), Mali (50), Sierra Leone (47.5) and Liberia (42). Most of the countries in the ECOWAS sub-regions have a life expectancy below 60 years. These figures show the deplorable state of healthcare in the ECOWAS sub-region despite the huge investments in this sector. The trend shown in table 3.1 indicates some marginal improvement but the rates are still far below the world's average with exception of Cape Verde.

**Table 3.1:** Life Expectancy in West Africa

COUNTRY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BENIN	55.81	56.21	56.63	57.07	57.49	57.87	58.22	58.51	58.75	58.94
BURKINA FASO	51.27	51.72	52.18	52.66	53.14	53.62	54.09	54.56	55.01	55.44
COTE DE IVORE	46.28	46.46	46.79	47.23	47.74	48.27	48.79	49.26	49.68	50.05
CAPE VERDE	70.51	70.97	71.42	71.87	72.30	72.71	73.11	73.49	73.86	74.21
GUINEA	51.44	51.75	52.19	52.75	53.35	53.94	54.48	54.93	55.30	55.59
GAMBIA	55.82	56.14	56.46	56.76	57.06	57.34	57.62	57.88	58.13	58.37
GUINEA-BISSAU	51.78	51.97	52.17	52.38	52.61	52.84	53.08	53.32	53.56	53.80
LIBERIA	52.81	53.33	54.10	55.07	56.14	57.19	58.11	58.86	59.43	59.86
MALI	50.02	50.53	51.03	51.52	51.99	52.45	52.90	53.34	53.77	54.19
NIGER	52.10	52.79	53.46	54.12	54.75	55.35	55.93	56.47	56.99	57.48
NIGERIA	47.22	47.64	53.46	48.66	49.23	49.79	50.33	50.83	51.29	51.71
SENEGAL	58.68	59.26	53.46	60.55	61.17	61.72	62.19	62.56	62.84	63.04
SIERRA LEONE	39.65	40.49	53.46	42.15	42.88	43.53	44.07	44.50	44.84	45.10
TOGO	53.69	53.82	53.46	54.14	54.34	54.57	54.84	55.14	55.47	55.81
GHANA	57.42	57.79	53.46	58.70	59.19	59.64	60.03	60.35	60.60	60.79

Source: World Development Index (2014)

Another outcome that reveals the state of health delivery in the sub-region is the maternal mortality rate. According to the CIA World Factbook, maternal mortality rate (MMR) is the annual number of deaths per 100000 live births from any cause related to or aggravated by pregnancy or its management (excluding accidental causes). The MMR includes deaths during pregnancy, childbirth or within 42 days of termination of pregnancy, for a specified year. According to estimates from WHO/UNICEF the West African rates appear to be among the world's highest. The bar chart below shows the comparison between the MMR for 1990 and 2010.

**Fig. 3.1:** Maternal Mortality in West Africa

Source: African Health Statistics (2012)

Most countries in West Africa have struggled with these high rates of maternal mortality. In recent times MMR in the sub-region have been on the decline in most countries though the rates are still very high when compared to other regional blocks. Ghana had an estimated rate of over 500 deaths per 100000 live births a decade ago but this has reduced to 350 as at 2010. This is due to policies introduced to curb this phenomenon. In 2004, Ghana introduced a national policy to exclude women from paying for delivery services in mission, public and private health care facilities. The exemption was funded from a debt relief fund under the Highly Indebted Poor Countries (HIPC) initiative. This was phased out gradually and taken over by the national health insurance scheme in 2008. This explains the success chalked in reducing MMR. However this is not enough for Ghana to meet its Millennium Development Goals of 185 maternal deaths per 100000 live births by 2015. Other

West African countries followed suite. Burkina Faso provides a subsidy of 80% on all deliveries. The prolonged civil war in Liberia has, however, led to a maternal mortality rate of 580 per 100000 live births currently.

HIV prevalence is another outcome of health expenditure which is of great concern to policy makers. Most countries in West Africa have seen decline in HIV/AIDS prevalence though the rates are still on the high side, for example, Senegal, Mali, Niger and Ghana. Niger has also introduced free treatment of under-five and free caesarean sections. This has led to some significant reduction in maternal and infant mortality. Despite these successes achieved by most countries, HIV/AIDS has continued to spread in other countries during the past decade. The average rate is currently 4% in the sub-region. This is quite high though lower than the rate of southern African countries which is 8% (WDI, 2012).

The major concern is that there is a high risk of incidence and also though there are efforts made in prevention and in antiretroviral treatment, there has not been any significant improvement. It is estimated that there are still about 5 million adults and children living with HIV/AIDS in West Africa alone. It very sad to note, that Africa still records the highest prevalence rate worldwide. The prevalence of HIV in Africa was 2740 per 100000 population whiles that of America, the next highest was just 341 (Atlas of African Health Statistics, 2012). The table 3.2 shows the prevalence of HIV in the sub- region. Prevalence here refers to the percentage of people ages 15-49 that are infected with HIV. The trend shows some marginal improvements across the region even though the rates are still very high when compared to rates worldwide. For instance, UK and US recorded rates as low as 0.3 and 0.6 respectively. From

table 3.2, Cape Verde has the lowest rate of 0.5 in West Africa while Guinea Bissau has the highest rates.

**Table 3.2:** Prevalence of HIV in West Africa.

COUNTRIES	2005	2006	2007	2008	2009	2010	2011	2012	2013
BENIN	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.1	1.1
CAPE VERDE	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
COTE D'IVOIRE	5.1	4.7	4.3	3.9	3.6	3.3	3.0	2.8	2.7
BURKINA FASO	1.3	1.2	1.2	1.1	1.0	1.0	1.0	1.0	0.9
GAMBIA	1.4	1.4	1.4	1.4	1.4	1.3	1.3	1.2	1.2
GHANA	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.4	1.3
GUINEA	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7
GUINEA B.	4.0	4.0	3.9	3.9	3.9	3.9	3.9	3.8	3.7
LIBERIA	2.4	2.1	1.9	1.7	1.5	1.4	1.3	1.2	1.1
MALI	1.3	1.3	1.2	1.2	1.1	1.0	1.0	0.9	0.9
NIGERIA	3.8	3.7	3.7	3.6	3.6	3.5	3.4	3.3	3.2
SERIA LEONE	1.5	1.6	1.6	1.7	1.6	1.6	1.6	1.6	1.6
SENEGAL	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5
TOGO	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.5	2.3

Source: World Development Indicators (2014)

The incidence rate of tuberculosis in the sub-region remains one of the highest on the globe apart from South Africa. As at 2010, Sierra Leone, Togo, Guinea, Liberia and Senegal recorded values far above the African and the world average. Quite worrisome is the fact that countries like Sierra Leone, Togo, Guinea and Liberia recorded values in 2013 that were far above the values recorded in 2000. This may be attributed to the high rate of HIV prevalence in the region. Table 3.3 presents the incidence of tuberculosis in the sub-region from 2005 to 2013. Incidence of tuberculosis here is the estimated number of new pulmonary, smear positive and extra

pulmonary cases per 100,000 people. Just like the prevalence of HIV, most countries in the sub region registered values that showed some marginal reductions in values over the years. In addition, countries like Nigeria, Guinea Bissau, Togo and Cote d'Ivoire that recorded very high rates of HIV prevalence also had high rates of incidence of tuberculosis. This may be attributed to the very high rate of HIV prevalence in the region. From the table, Ghana has made a significant reduction in rates from 119 in 2005 to 66 in 2013. Liberia on the other hand, has rather recorded an increase in rates over the same period from 267 to 308.

**Table 3.3:** Incidence of tuberculosis

COUNTRY	2005	2006	2007	2008	2009	2010	2011	2012	2013
BENIN	73	71	70	70	70	69	70	70	70
CAPE VERDE	153	152	151	149	148	147	145	144	143
COTE D'VOIRE	267	249	233	219	207	196	186	178	170
BURKINA FASO	64	63	62	61	60	58	57	55	54
GAMBIA	191	189	186	183	180	178	176	175	173
GHANA	119	112	105	99	92	85	79	72	66
GUINEA	210	206	200	195	190	186	183	180	177
GUINEA B.	361	366	367	368	369	372	376	382	387
LIBERIA	267	272	277	282	288	293	299	304	308
MALI	69	68	66	65	64	63	62	61	60
NIGERIA	343	343	342	341	340	339	339	339	338
SIERA LEONE	316	317	318	318	318	317	316	314	313
SENEGAL	141	139	138	136	136	136	316	136	136
TOGO	78	76	74	73	72	317	316	314	313

Source: World Development Indicators (2015).

Malaria prevalence is an outcome that is a burden on government of West Africa. Prevalence here means the proportion of a population infected at a single point in time. About 90% of the overall malaria deaths worldwide occur in Africa. One major reason given by health officials is that most infections in Africa are caused by the

most dangerous of the four malaria parasites, plasmodium falciparum. In addition, the mosquito anopheles gambiae, the malaria vector is very hard to control

Finally lifestyle diseases which used to be the preserve of the industrialized states have now become a common phenomenon in Africa and the ECOWAS sub-region. This can be attributed to increased industrialisation, changing lifestyle and growing income. These have led to an increase in conditions such as hypertension, diabetes, obesity, cancer and others. The WHO predicted that chronic disease will become the most common killer in Africa by 2030. The combinations of chronic diseases with the communicable ones in addition to poor and non-existing infrastructure have placed an unbearable stress on health care within the sub-region.

### **3.3. Public Health Expenditure in the ECOWAS Sub-Region**

Despite the marginal improvements recorded in some areas, the outcomes show the deplorable healthcare delivery in the region. Currently, sub-Saharan Africa makes up about 11% of the world population. However, 24% of the global disease burden is found here according to International Finance Corporation. Worse of all, the region commands just 1% of all global health expenditure. Health expenditure remains very low across the sub-region. In April 2001, African leaders met in Abuja, Nigeria where they signed an agreement popularly called ‘The Abuja Declaration.’ In this agreement, they pledged to increase government expenditure for health to 15% and pleaded with donor agencies to help support their course. The African Union Commission reports that as at 2012, only 6 African countries have met the 15% benchmark among which just 2 are from ECOWAS sub-region. An examination of government spending on health across the sub-region over the last 10 years shows a marginal increase in some countries while others actually reduced their spending.

Table 3.4 below shows the general government expenditure on health as a percentage of total government expenditure. From the table, expenditure on health as a percentage of GDP ranges between 1.1 and 16.9 in West Africa over the ten year period.

**Table 3. 4:** Public Expenditure on Health (% of GDP)

COUNTRY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BENIN	1.9	2.2	2.2	2.4	2.4	2.3	2.1	2.3	2.2	2.3
BURKINA FASO	2.2	2.6	3.3	4.1	4.2	4.6	5.1	3.6	4.1	3.2
CAPE VERDE	3.9	3.7	3.8	3.6	4.0	3.4	3.0	3.2	3.3	3.0
COTE D'IVOIRE	1.5	1.5	1.6	1.3	1.4	1.5	1.6	1.8	1.8	1.7
GAMBIA	1.4	2.1	2.5	2.4	2.5	2.0	2.1	2.7	2.7	2.9
GHANA	4.8	4.8	6.1	7.0	5.4	6.0	5.6	5.1	5.3	5.3
GUINEA	1.3	0.8	0.9	0.9	0.9	1.1	1.3	1.7	2.0	1.5
GUINEA-B	1.3	1.3	0.9	1.1	1.1	1.4	1.2	1.9	2.3	1.7
LIBERIA	1.1	1.2	2.4	1.6	2.0	2.8	2.8	3.3	2.4	4.6
MALI	2.5	2.7	3.1	3.0	3.2	3.4	3.1	3.1	2.8	3.0
NIGERIA	3.9	7.5	7.0	6.6	5.7	7.2	6.5	6.8	5.6	5.7
NIGER	7.0	6.8	7.1	7.7	7.9	7.4	7.1	7.7	6.9	6.8
SENEGAL	5.1	5.4	5.7	5.4	5.4	4.7	4.9	4.8	4.8	5.0
SIERRA LEONE	16.0	15.5	15.4	15.9	14.2	14.0	14.2	16.9	15.4	16.3
TOGO	5.0	5.6	5.9	6.6	6.4	6.5	6.5	7.2	7.5	8.0

Source: World Development Indicators (2014).

The concern of policymakers has generally centred on whether increasing the expenditure on health care results in higher outcomes and better quality of life? A recent research conducted by Pricewaterhouse Coopers Health Research institute

discovered that the United States of America spends about US\$2 trillion on health each year and more than half of this amount is wasted. In addition, the European Healthcare Fraud and Corruption Network states that out of the annual health expenditure of about US\$5.3 trillion, about 6% (i.e. US\$ 300 billion) is lost to mistakes and corruption (World Health Report,2010). As far as corruption and wastage is concerned, the ECOWAS sub–region has one of worst index worldwide. This implies that if efficiency is taken seriously, we can make a lot of saving and improve on most of the outcomes in the region.

### **3.4 Education Outcomes in the ECOWAS Sub-Region**

Education is important for every aspect of human, social and economic development. The world today is knowledge and education and the growth of every economy largely depends on the quality of the human resource base. The United Nations Educational, Social and Cultural Organization (UNESCO) declared education as a fundamental human right that every individual must have access to. Accordingly, Article 1 of the World declaration on Education for All reads: “Every person – child, youth and adult – shall be able to benefit from educational opportunities designed to meet their basic learning needs”. The Convention on the Rights of the Child (CRC) states that ‘every child has the right to an adequate standard of living, and the highest attainable standard of health and education on the basis of equity of opportunity’.

In 1990 UNESCO, UNDP, UNFPA, UNICEF and The World Bank launched the “Education for all” movement. This movement is a global commitment to provide quality basic education for all children, youth and adults. The principal aim of this declaration was primarily to ensure that member and signatory countries made a

commitment to make primary education universal and to massively reduce the rate of illiteracy by the end of the decade ([www.unesco.org](http://www.unesco.org)).

Ten years after its launch, it was observed that many countries could not meet this targeted objective. The international community, therefore, met again in Dakar, Senegal and affirmed their commitment to achieving Education for All (EFA) by 2015. They identified six internationally agreed education goals that can help meet the learning needs of all children, youth and adults by 2015. These goals include expanding and improving comprehensive early childhood care and education; ensuring that by 2015 all children, particularly girls, children in difficult circumstances have access to and complete free and compulsory primary education; equitable access to education; achieving a 50% improvement in levels of adult literacy by 2015, achieving gender equality in education by 2015 and finally ensuring excellence in all aspects so that measurable outcomes are achieved in literacy and numeracy.

The goals of “Education For All” (EFA) also contribute much to the achievement of the eight Millennium Development Goals. Educational outcomes show that ECOWAS member states have made some progress towards achieving some of EFA goals and MDGs. The share of children completing primary schools has increased from 52% to 67% over 2002 - 2010 in the ECOWAS sub-region. Gender equality has also improved even above the SSA average.

With respect to the primary school completion rate, indicators for 2011 show that Ghana and Cape Verde have rates that are above 90%. In most of the ECOWAS countries, more than 30% of children do not complete their cycle. Burkina Faso and

Niger have primary completion rates that are lower than 50%. The ECOWAS average as at 2011 is 67% which is lower than the SSA average of 69.7% ([www.ecowas.int](http://www.ecowas.int)).

With regards to literacy rates, the ECOWAS sub-region currently records the lowest literacy rates worldwide. Literacy rate refers to percentage of the population from age fifteen years (15) and above who can read and write a short, simple statement on their everyday life with understanding. This indicator is calculated by dividing the number of literates age 15 years and above by the corresponding age group and multiplying the result by 100.

As at 2009, 65 million adults in West Africa, representing forty percent (40%) of the adult population could neither read nor write according to a study by The African Network Campaign for Education for all (ANCENFA), Pamoja, and non-profits Oxfam International and Action Aid (<http://www.irirnews.org>). Out of the ten countries with the world's lowest literacy rates, seven are in West Africa. They are Benin, Niger, Senegal, Sierra Leone, Guinea, Mali and Burkina Faso. Despite the low rates of literacy, the ECOWAS sub-region has recorded some progress over the 2002 figures. The average for the region in 2002 was 43.7%. In 2011, it increased marginally to 51.9% while the SSA average also increased from 60.2% to 67.3% over the same period. There is, therefore, a lot to be done to catch up with the SSA rates.

Primary and secondary enrolment rates are the total enrolment in primary education, regardless of age, expressed as a percentage of the population of official primary education age. The sub-Saharan African region has seen a remarkable rise in primary and secondary school enrolment over the past decade. More children are reaching the last grade of primary school with the aspiration of going onto secondary education, but there are places for just 36% of children of age to enroll. The low proportion

indicates that countries are facing significant challenges in meeting the demand for secondary education. More than 21.6 million children of lower secondary school age in the region remain excluded from school and many are expected never to enter school. Girls bear the brunt of high illiteracy and drop-out within the sub-region. When a girl enters lower secondary school, her chances of completing this level and moving onto upper secondary education are slim. Sub-Saharan Africa is the only region in the world where girls are increasingly disadvantaged at the upper secondary level; there are now only 76 girls for every 100 boys. Between 1999 and 2009, the school-aged population and enrollment increased by 25% and 59% respectively. Tables 3.5, 3.6 and 3.7 show trends in enrolments at primary, secondary and tertiary levels from 2002 to 2011.

**Table 3.5: Primary Enrolment in West Africa (%)**

COUNTRIES	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BENIN	94.379	97.84089	101.5409	98.54523	98.79342	-	110.0343	114.8737	116.2895	118.6075
BURKINA FASO	47.05245	49.30155	53.86393	58.3205	62.06524	67.66018	73.22735	77.68096	78.35542	82.23843
COTE D'IVOIRE	81.27893	76.95225	-	-	74.41135	75.24804	79.88928	79.57397	-	89.9602
CAPE VERDE	121.4456	119.3325	116.2722	114.2446	113.5333	112.0176	111.4977	111.0594	111.1295	111.5388
GUINEA	70.00276	73.95233	77.597	80.12843	82.08393	84.18937	85.14143	84.59576	86.35974	89.30437
GAMBIA	89.53287	93.09201	93.71212	90.82815	88.79996	90.16967	87.86594	90.59012	85.1533	82.45315
GUINEA-BISSAU	-	-	106.7553	113.9638	119.9187	-	-	-	116.2216	-
LIBERIA	-	-	-	-	92.52455	-	93.25601	99.63831	-	102.3847
MALI	71.60815	73.39369	76.73145	80.11179	83.04336	85.57691	87.61859	89.25072	90.31071	91.66347
NIGER	41.0481	44.31851	48.32703	50.038	50.62768	53.12782	57.05226	60.94133	64.7819	68.87326
NIGERIA	97.64834	-	100.2566	100.9261	101.6673	92.89026	83.76665	85.03594	84.80488	-
SENEGAL	70.86729	74.72312	78.67306	80.54235	80.63379	84.35902	84.91031	84.56286	84.41316	83.5257
SIERRA LEONE	-	-	-	-	-	-	-	-	-	128.0916
TOGO	116.9747	114.7441	113.9252	113.3227	117.5621	111.9312	113.1159	128.2267	131.4211	129.5496
GHANA	83.74326	80.10215	83.8068	90.36097	95.34689	100.9564	106.7092	105.5338	-	106.7352

Source: World Development Indicators (2014)

**Table 3.6: Secondary Enrolment Sub Saharan Africa (%)**

COUNTRY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BENIN	25.3	26.6	28.3	34.6	-	-	-	-	-	47.7
BURKINA FASO	10.7	12.1	13.2	14.3	15.0	16.2	18.9	20.3	21.9	23.8
CAPE VERDE	68.3	69.2	68.6	72.2	84.4	83.9	86.1	85.3	87.8	90.4
GUINEA	20.6	22.3	24.6	29.3	32.8	-	34.3	-	-	38.1
GAMBIA	-	-	-	-	-	-	57.8	58.8	57.5	-
GUINEA-BISSAU	-	-	-	32.4	34.5	-	-	-	-	-
MALI	-	23.5	25.5	27.6	29.7	32.6	36.4	39.6	42.4	44.5
NIGER	6.9	7.6	9.2	10.1	11.5	11.1	11.5	12.1	13.8	14.7
NIGERIA	29.4	-	34.8	34.7	34.2	31.6	35.1	38.9	43.8	
SENEGAL	17.4	-	20.6	22.6	24.3	-	30.4	-	36.4	41.0
TOGO	38.9	41.1	42.6	45.0	47.0	44.0	-	-	-	54.9

Source: World Development Indicators (2014)

**Table 3.7:** Tertiary Enrolment in West Africa(%)

COUNTRY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BENIN	5.3	5.8	5.9	5.8	5.6	-	-	9.9	-	12.4
BURKINA FASO	1.4	1.6	-	-	2.4	2.6	3.2	3.5	3.6	4.1
COTE D'IVOIRE	-	-	-	-	-	9.6	-	9.0	8.4	-
CAPE VERDE	3.9	4.5	6.0	7.4	8.4	9.6	12.0	15.1	18.0	20.6
GUINEA	-	2.2	2.1	2.9	5.0	7.8	8.9	9.0	10.3	10.4
GAMBIA	-	-	1.2	-	-	-	4.5	-	-	-
GUINEA-BISSAU	-	-	-	2.3	2.6	-	-	-	-	-
LIBERIA	-	-	-	-	-	-	-	-	9.3	-
MALI	2.2	-	-	-	-	5.1	5.7	6.3	6.5	6.9
NIGER	-	1.0	0.9	1.1	1.2	1.1	1.2	1.5	1.5	1.6
NIGERIA	-	9.6	9.9	10.4	-	-	-	-	-	-
SENEGAL	-	-	5.1	5.6	5.8	6.4	8.0	8.0	7.6	-
SIERRA LEONE	2.0	-	-	-	-	-	-	-	-	-
TOGO	-	-	-	-	5.0	5.7	-	-	9.1	10.1
GHANA	-	-	-	5.7	5.1	6.4	8.4	8.8	-	12.1

Source: World Development Indicators (2014)

Achieving parity in education is considered an important step in the promotion of gender equality and the empowerment of women, [The MDG 2012 report](#) finds many more of the world's children are enrolled in school at primary level, especially since 2000, with girls benefiting the most. There were 97 girls enrolled per 100 boys in 2010 – up from 91 girls per 100 boys in 1999.

In ECOWAS, and as at 2012, 35% of primary school-aged children on average (39.7% for girls) are out of school, which is far above the SSA average of 21.5%. Indeed progress over the decade has been marginal in comparison to the region (the rate has dropped by just 3 percentage points in ECOWAS, against 13 percentage points for SSA), and primary pupil retention is generally low and has marginally receded, in line with the SSA trend. The variation by country is considerable, however, only about 6% of primary school-aged children are out-of-school in Benin, Cape Verde and Togo, whereas the rate is above 15% in all other countries, and over

36% in Burkina Faso, Côte d'Ivoire, Niger and Nigeria. For the ECOWAS region as a whole, this figure means that 17 million primary school-aged children are yet to be enrolled, way above the figures for SADC and EAC, of 2.8 million and 2 million children respectively (UNESCO, 2012).

The provision of teachers in sufficient numbers is progressing well within the ECOWAS region, with an average pupil-teacher ratio having fallen from 42:1 to 39:1. By 2012, the supply of teachers had almost doubled in Niger, an increase of more than 88 per cent in comparison to 2006; huge gains were also recorded in Burkina Faso and Côte d'Ivoire. Although men continue to outnumber women, the new entrants to the profession are predominantly females. The level of inequality grows as one move up the education levels. For example, in 2006, at the primary level 41 percent of teachers were female while at the secondary level only 25 per cent were female. The majority of member states register a decline, and 10 out of 15 countries offer average class sizes of fewer than 45 pupils. However, there are some challenges in Burkina Faso, Côte d'Ivoire, Guinea Bissau and Mali, where overcrowding is more common. Despite the apparent progress in the provision of qualified teachers (at 67%, their share is up four percentage points) this share is still below the SSA average, and in Guinea Bissau and Togo rates are stagnant below 40%. Although the availability of textbooks is reasonable in regional context, few countries (Benin, Cape Verde, Guinea, Mali and Niger) provide almost all pupils with both a reading and a math book. Learning outcomes clearly suffer as a result ([www.ecowas.int](http://www.ecowas.int)).

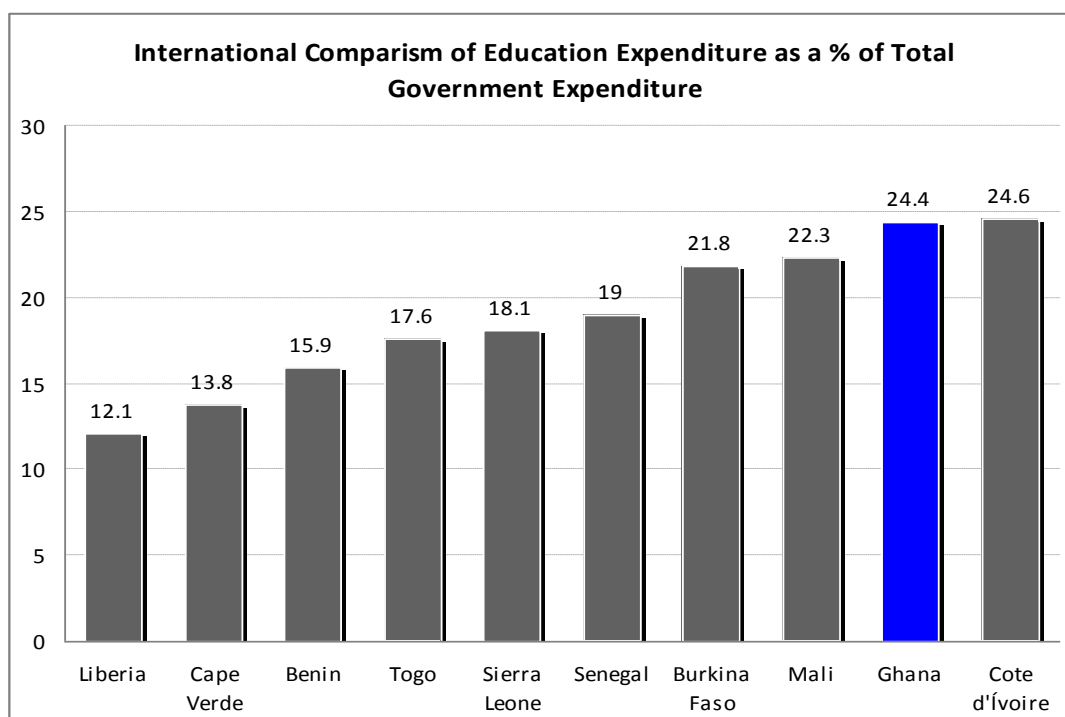
Generally, higher education in West Africa has gone through some expansion over the past six years, with increased learner access. One fourth of the 8.6 million students enrolled in tertiary institutions globally in 2006 were in the ECOWAS region. It is

also worth mentioning that the highest concentration of graduates is in Cape Verde, which reported a 166 per cent increase from 2006. Data from the three reporting countries, however, point to a situation where women's participation in tertiary education remains subdued. Less than one third of tertiary graduates in Burkina Faso and Guinea are female, with Ghana faring slightly better with 39.4 per cent of graduates being females. It is evident that the bulk of higher and tertiary education students in the region are studying social sciences, business and law, with more than half of learners in Burkina Faso and Cape Verde, and a third in Niger, enrolled in these fields (AU Outlook on Education Report, 2014).

### **3.5 Government spending on education**

Over the past decade, countries in the ECOWAS sub – region have been spending a significant proportion of their total expenditure on education. Expenditure on education here is made up of both current and capital expenditure on educational institutions and education administration. The share of government spending as a percentage of total government spending is an indication of the commitment of a country to the development of education. For instance, between 2006 and 2009, Ghana allocated 23.1% of its resources to education which is the second highest in the sub – region. As at 2011, Ghana increased its share of total government spending to as much as 30%. Fig. 3.3 shows the percentage of total expenditure spent on education in some of the countries in the sub – region in 2009. Ghana ranked 2<sup>nd</sup> in terms of share of government expenditure allocated to education after Cote D'Ivoire. Liberia, Cape Verde and Benin are the three countries with the lowest shares in the sub – region.

Table 3.8 displays government expenditure on education as a percentage of GDP in West Africa between 2002 and 2011. The trend shows an increase in spending over the period in most of the countries. Only Togo, Sierra Leone and Burkina Faso registered a decrease in values over the period. Ghana ranked first by gradually increasing its spending from 22.1 % in 2002 to 33.1% in 2011.



Source: African Health Statistics (2012)

**Table 3.8:** Government expenditure on education as a percentage of GDP

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BENIN	14.1	16.7	19.2	18.8	19.7	14.9	19.1	18.2	26.1	-
BURKINA FASO	-	-	-	19.5	18.2	17.2	-	-	16.1	14.4
COTE DE IVORE	22.4	22.5	22.0	21.6	20.3	21.5	21.8	-	-	-
CAPE VERDE	19.8	-	20.8	-	17.5	18.3	18.6	16.2	14.4	15.2
GUINEA	13.1	11.6	12.3	10.9	-	-	14.0	13.6	12.4	14.3
GAMBIA	8.8	8.2	4.8	5.3	5.4	7.3	18.8	13.3	17.1	15.1
MALI	14.5	18.3	17.7	16.3	-	-	18.0	17.0	18.9	19.5
NIGER	16.7	13.9	-	-	16.9	17.4	16.2	18.9	18.1	21.7
SENEGAL	16.7	16.1	17.0	21.8	18.0	-	19.2	20.9	20.7	-
SIERRA LEONE	17.7	17.3	17.1	15.5	-	19.8	14.9	15.9	12.8	12.4
TOGO	30.7	27.8	21.8	17.7	17.3	18.2	19.2	19.4	19.6	18.6
GHANA	22.1	22.2	22.4	23.4	24.2	23.9	23.6	22.7	21.2	33.1

Source: World Development Indicators (2014)

## CHAPTER FOUR

### METHODOLOGY

#### 4.1 Introduction

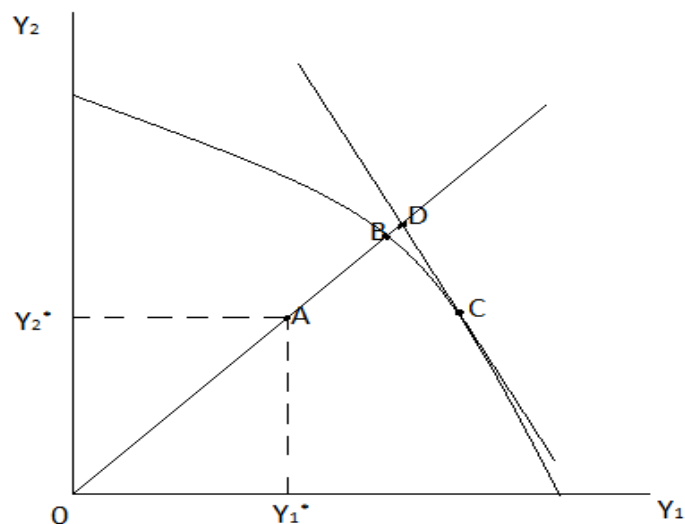
This chapter develops the general stochastic frontier which will be used to estimate the technical efficiency of government expenditure in health and education sectors in the ECOWAS sub-regions. It begins with the development of both the conceptual and the analytical framework to measure technical efficiency based on production function. It also lays down the methodological assumptions and the framework of the stochastic frontier model.

#### 4.2 Conceptual Framework

Our conceptual framework embodies the textbook definition of production frontier and the Debreu–Farrell interpretation of technical and allocative efficiency. A producer's technical efficiency is characterized by the relationship between the observed production and some ideal or potential or optimum production (Greene, 2005). If a producer's actual output lies on the production frontier, it is efficient. If the production point lies below the frontier, it is technically inefficient. Technical inefficiency, therefore, occurs when the actual or the observed output from a given set of inputs is less than the maximum possible output. In order to maximize profit, the firm has to produce the maximum output given the level of inputs employed. This can be illustrated using a two input  $(X_1, X_2)$  - two outputs  $((Y_1, Y_2))$  production process as shown in figure 4.1. From the figure above, the firm's output at point A, can be expanded radially to point B, which is on the frontier and hence technically efficient.

Therefore, the output oriented measure of technical efficiency  $\left[ E_o(Y, K) \right]^{-1}$ , can be given by  $O_A/O_B$ . While point B is technically efficient since it lies on the possibility frontier, higher revenue could be made at a point C where the marginal rate of transformation is equal to the price ratio  $P_1/P_2$ . In this case, more of  $Y_1$ , should be produced and less of  $Y_2$  in order to maximize revenue (Kumbhakar and Lovell, 2000).

**Fig. 4.1: Output orientated Efficiency measure**



Source: Kumbhakar and Lovell, 2000

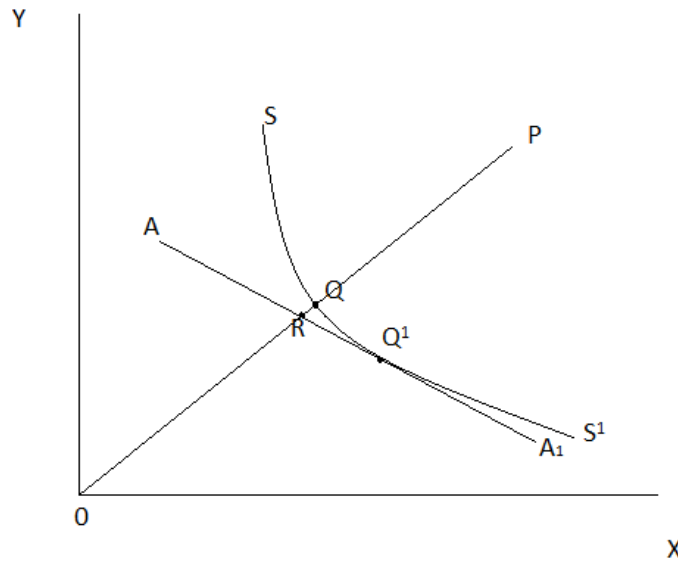
Using the Debreu-Farrell measure of technical efficiency, we can consider technical efficiency as the ability of the firm to produce maximum output from a given set of inputs.

If we are to consider a producer employing two factors of production, we assume that the efficient production function is known. Point P in figure 4.2 represents the inputs

of the two factors, per unit of output, that the firm is observed to use. Q represents an efficient firm using the two factors in the same ratio as P. It can be noted that the same output as P is produced using a fraction  $OQ/OP$  as much of each factor.  $OQ/OP$  can be defined as the technical efficiency of the point P.

A perfectly efficient firm takes the value unity or 100%. As more units of inputs per unit of output are employed, the value becomes smaller. In addition, since the isoquant SS has a negative slope; a reduction in the input per output of a factor will imply higher technical efficiency, all other things being equal.

**Fig. 4.2;** A Debreu – Farrell measure of technical efficiency



### 4.3 Analytical Framework

The choice of an econometric model depends on the type of data used, i.e. whether cross-section or panel, the type of variables and the number of equations in the model.

Most econometric techniques are enveloping techniques. Technical efficiency is measured in terms of distance to a production frontier. For a cross-sectional production frontier model, let's consider the following

Suppose a producer uses  $X$  inputs to produce  $Y$  output with technology

$$Y_i \leq f(X_i; \beta) \exp(v_i) \dots \dots \dots (1)$$

where;

$\beta$  = A parameter vector showing the structure of production technology.

$f(X_i; \beta)$  = The deterministic production frontier, with the random disturbance term

$V_i \geq 0$  or  $V_i < 0$  included to capture the effects of statistical noise on observed output.

The inequality in equation (1) can be converted to equality by introducing a second disturbance term to give us

$$Y_i = f(X_i; \beta) \exp(v_i - u_i) \dots \dots \dots (2)$$

where the disturbance term  $U_i \geq 0$  is included to capture the effect of technical inefficiency on the observed output. Various approaches have been developed to estimate equation (2). These include the Corrected Ordinary Least Squares, the Modified Ordinary Least squares and the Stochastic Frontier Analysis.

In the use of the Corrected Ordinary Least Squares (COLS) in efficiency measurement, the Ordinary Least Square (OLS) approach is used to first estimate the parameters and the intercept values simultaneously. The estimated production function, which intercepts the data, is then shifted up by adding the maximum positive residual to the estimated intercept. This creates a production frontier that bounds the data from above. The correction of the biased intercept is shown below:

$$\beta^* = \beta_0 + \max(\hat{U}_i)$$

where  $\beta_0$  and  $\hat{U}$  are the intercept and the residuals from the OLS respectively and  $\beta^*$  is the intercept of the COLS model. The bias in the model is corrected by rewriting the residuals in the opposite direction as

$$-\hat{U}^* = \hat{U}_i - \max(\hat{U}_i)$$

Technical efficiency is then measured as  $TE_i = e(-\hat{U}_i)$  and  $TE_0(X_i, Y_i) - 1 \geq 0$  and indicates the percentage by which output can be expanded on the assumption that  $U_i = 0, i=1, \dots, 1$ . One advantage of this approach is that it is very simple and easy to use and hence it is widely used.

The structure of the COLS frontier is identical to the structure of the OLS function. This rules out the possibility that efficient producers are efficient due to the fact that they exploit available economies and substitution possibilities that average producers do not (Harold et al, 2006).

Battese and Coelli (1995) argue that this approach does not produce consistent firm level inefficiency. According to them, the firm specific characteristic should be included into the specification of the production frontier and the inefficiency model since this will have a significant effect on the efficiency score. Kuwornu et al (2013) also argue that we may not be able to identify the structure of the best practice production technology.

The terminology was suggested by Lovell (1993). Measurement of efficiency using The Modified Ordinary Least Squares (MOLS) approach is a deterministic frontier method. The terminology was suggested by Lovell (1993). This method makes use of the standard OLS assumptions. The disturbance term follows a one sided distribution such as the half-normal and exponential distribution. Just like in the COLS, the biased

intercept in the OLS is modified by using the mean of the assumed one-sided distribution. This is stated as:

$$\beta^{**} = \beta_o + E(U_o)$$

$$-\hat{U}^{**} = \hat{U}_i - E(\hat{U}_i)$$

The main limitation of this approach is that it is possible to obtain technical efficiency scores that are greater than 1. The implication is that some firms produce output beyond the efficient frontier. However, the MOLS is attractive since it is easy to use. In addition, Richmond (1970), states that the COLS and the MOLS are basically the same.

The Production Frontier Analysis is the methodology employed in this study. A detailed description of the model is discussed in the next section.

#### **4.3.1 The Stochastic Frontier Analysis**

A frontier function can be said to be a best-practice technology against which the efficiency of the firm within the industry can be measured. (Coelli, 1995). If a firm is beneath the efficiency frontier, then it is technically inefficient. Two main primary approaches to efficiency measurement have been identified: parametric, which involves econometric methods and non-parametric, which employs mathematical programming. This study employs the stochastic frontier analysis (SFA) which is an econometric approach. Various approaches have been developed to measure the level of inefficiency of producers. However, the focus of this methodology employed in this study is the Stochastic Frontier Analysis (SFA). This was independently proposed by Aigner, Lovell, Schmidt (1977) and Meeusen and Van Den Broeck (1977). Their motivation for proposing this technique of measuring efficiency is that the deviations from the production frontier might not be under the control of the producer.

The idea of the stochastic frontier can be illustrated by a firm using 'k' inputs ( $X_{a1}, X_{a2}, \dots, X_{ak}$ ) to produce output 'Y'. Efficient transformation of inputs into output is characterised by the production function  $f(X_i)$  which shows the maximum output that can be obtained from the given inputs. With the presence of technical inefficiency in the production process, the stochastic frontier is specified as

$$Y_i = f(X_i; \beta) + \varepsilon \quad \varepsilon_i = v_i - u_i$$

$Y_i$  represents the output of the  $i$ th producer,  $f(X_i; \beta)$  is a suitable function such as Cobb Douglas or translog functions of vector  $X_i$  of inputs for the  $i$ th producer and a vector of  $\beta$  of unknown parameters.  $U_i$  is the non-negative random variable that captures the effect of technical inefficiency. It assumed to be distributed independently as  $N^+(0, \delta_u^2)$ .  $U_i$  can take any distributional assumptions such as half-normal distribution exponential distribution; and the normal-gamma density (Greene, 1980).  $V_i$  is symmetric and distributed independently of  $U_i$  with zero mean and a constant variance i.e.  $N(0; \delta_v^2)$ . The  $V_i$  is a random error which is associated with random factors such as measurement errors in production and other factors beyond the control of the producer.

From the above, our observed output can be given as  $Y_i = f(X_i; \beta) + V_i$ ;  $U_i = 0$

Hence the technical efficiency of the  $i$ -th producer given the inputs is the ratio of the observed output to the frontier output. Is

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{f(X_i; \beta)e^{v_i - u_i}}{f(X_i; \beta)e^{v_i}}$$

$$TE_j = \frac{f(X_i; \beta) + v_i - u_i}{f(X_i; \beta) + v_i}$$

Where  $Y_j^*$  = frontier output and  $TE_i = \exp(-U_i)$

A producer is therefore technically efficient if its output is on the frontier, i.e.

$\frac{Y_i}{Y_j^*} = 1$ . However, technical efficiency close to zero is an indication of inefficiency

of the producer. In other words, the higher the value of  $U_i$ , the higher the level of technical inefficiency. A zero  $U_i$  implies the producer is technically efficient and hence deviations from observed output and frontier output are caused by factors outside the producers' control.

Since the introduction of the stochastic production frontier by Aigner, Lovell and Schmidt, there has been some considerable research to extend, modify and apply the model. Pit and Lee (1981) were the first to extend the cross sectional model, given as

$$Y_i = \alpha + X_i \beta + \varepsilon_i$$

$$i = 1, \dots, N$$

They propose ML estimation of the following stochastic frontier model

$$Y_i = \alpha + X_i \beta + \varepsilon_{it}, \text{ where, } \varepsilon_{it} = v_i - u_i$$

$$V_{it} \sim N(0, \delta_v^2) \text{ and } U_{it} \sim N(0, \delta_u^2)$$

Jondrow et al (1982) proposed a conditional estimator for the inefficiency term and the specified distributional assumption about the inefficiency effect is estimated by maximum likelihood estimation approach. Battese and Corra (1977) also provides an alternative estimation approach for technical efficiency obtained by parameterization as follows:

$$\delta^2 = \delta_v^2 + \delta_u^2 ; \quad \gamma = \frac{\delta_u^2}{\delta^2} = \frac{\delta_u^2}{(\delta_v^2 + \delta_u^2)} ;$$

$$\lambda = \frac{\delta_u^2}{\delta_v^2}$$

where  $\sigma^2$  is the total variation from the model,  $\sigma_v^2$  is the variation as a result of statistical noise and  $\sigma_u^2$  the variation arising from inefficiency. The  $\gamma$  parameter measures the degree of variability between the production process as to whether the difference in production is due to technical inefficiency or wholly due to random factors. If  $\gamma = 0$ , it implies that the variability in production is as a result of the effects of statistical disturbances and not from technical inefficiencies. However if the estimated  $\gamma=1$ , then this implies that differences in production arises as a result of inefficiencies. If the variance parameter  $\gamma$  lies within the range of 0 and 1 ( $0 < \gamma < 1$ ), then the difference from the frontier output is attributed to both stochastic errors and technical inefficiency.

However the time invariant nature of the efficiency term has been criticised. In order to provide a solution to this problem, Cornwell et al (1990) proposed the following stochastic frontier model with individual-specific slope parameters.

$$Y_{it} = \alpha + X_{it}^1 \beta + v_{it} - u_{it} \quad i=1, \dots, N$$

$$U_{it} = W_i + W_{it} + W_{it}^2$$

The parameters in the model are estimated by extending the conventional fixed and random effects panel data estimates. The problem here is that the quadratic specification requires the estimation of larger number of parameters. Lee and Schmidt (1993) develop an alternative for estimating  $U_{it}$ :

$$U_{it} = g(t)U_i$$

\Where  $g(t)$  refers to a set of time dummy variables. This estimation is less flexible since it limits the temporal pattern of the  $U_{it}$ . Schmidt and Sickles (1984) consider a case for panel data. Their model is given as:

$$Y_{it} = \alpha + X_{it}\beta + v_{it} - u_{it} \text{ where } i = 1, \dots, N, \quad t = 1, \dots, T$$

$U_i$  represents technical inefficiency and it is greater or equal to zero. This model has a firm effect but no time effect. In their model, only the intercept varies over firms. Differences in the intercept are interpreted as differences in efficiency levels. In addition, this model relaxes the strong distributional assumptions about technical inefficiency and the explanatory variables. Battese and Coelli (1995) criticises previous extensions of the model for adopting a two stage approach in which the first stage involves the specification and estimation of the stochastic frontier production function and the production of technical inefficiency effects, under the assumptions that these inefficiency effects are identically distributed. The second stage involves the specification of a regression model for the predicted technical efficiency effects in the stochastic frontier. The model proposed by Battese and Coelli (1995) for panel data is given as

$$Y_i = \exp(X_{it}\beta + v_{it} - u_{it})$$

The technical inefficiency effect,  $U_{it}$  in the model is specified as

$$U_{it} = Z_{it} + W_{it}$$

$Y_{it}$  denotes the production at the  $t$ -th observation ( $t=1,2,\dots,T$ ) for the  $i$ -th firm ( $i=1,2,\dots,N$ ),  $X_{it}$  is a  $(1 \times k)$  vector of known functions of inputs of production and other explanatory variables associated with the  $i$ -th firm at the  $t$ -th observation:  $\beta$  is a  $(k \times 1)$  vector of unknown parameters to be estimated.  $V_{it}$  is assumed to be iid  $N(0, \sigma_v^2)$  random errors independently distributed of the  $U_{it}$ .

$U_{it}$ s are non-random variables, associated with the technical inefficiency of production, which are assumed to be independently distributed, such that  $U_{it}$  is

obtained by truncation (at zero) of the normal distribution with mean  $Z_{it}\delta$  and variance,  $\sigma^2$ . The technical inefficiency,  $U_{it}$ s are assumed to be a function of a set of explanatory variables,  $Z_{it}$  and an unknown vector of co-efficient,  $\delta$ . The random variable,  $W_{it}$ , is defined by the truncation of the normal distribution with zero mean and variance,  $\sigma^2$ . Battese and Coelli also propose the maximum likelihood for the estimation of the parameters of the stochastic frontier and the model for the technical inefficiency effects.

The technical efficiency of production for the  $i$ -th firm at the  $t$ -th observation is given as:

$$TE_{it} = \exp(-U_{it}) = \exp(-Z_{it}\delta - W_{it})$$

Greene (2005) provided an extension that provides a solution for two criticisms of earlier models. The first one is that conventional panel data estimators assume that technical or cost efficiency is time invariant. Secondly, the same term used to capture the inefficiency for the random and fixed estimators also contains time invariant cross unit heterogeneity. He proposes a ‘true’ fixed effect model as

$$\ln Y_{it} = \alpha_i + \beta^T X_{it} + v_{it} - u_{it}$$

$$U_{it} \sim N(0, \delta_v^2)$$

$$U_{it} \sim \left[ N(\bullet, \delta^2) \right]$$

Greene (2005) also considers a ‘true’ random effect model that modifies the parameterised models given as

$$\ln Y_{it} = (\alpha + W_i) + \beta^T X_{it} + v_{it} - u_{it}$$

$$V_{it} \sim N(0, \delta_v^2)$$

$$U_{it} \sim N(0, \delta_u^2)$$

$$W_{it} \sim \text{with mean 0 and finite variance}$$

#### **4.4 The Empirical Model**

We employ the stochastic frontier analysis developed simultaneously by Aigner et al (1977) and Meeusen and Van den Broeck (1977). Countries are considered as producers of output measured by social outcomes given the inputs (expenditure incurred in the provision of the output). The SFA constructs an efficient frontier by assuming a common production frontier technology across all countries in the selected sample. Deviations from the frontier are decomposed into efficiency and noise. The noise captures all exogenous factors outside the control of the decision making unit. Analysis of literature on the efficiency of government expenditure across countries reveals two approaches in the empirical application of the stochastic frontier analysis. The first one, the two stage approach estimates efficiency scores in the first stage. In the second stage, country specific efficiency scores are regressed against some explanatory variables in order to examine the determinants of efficiency in these countries.

This approach however has some fundamental contradiction. The assumption about the inefficiency term in stage one is that it is independently and identically distributed. Stage two however contradicts the identical distribution assumption of the first stage (Kumbhakar et al, 1991). This study therefore applies the Battese and Coelli (1995) model since it overcomes this contradiction as it allows the estimation of both the frontier and efficiency term in one stage. The choice of a functional form is of great importance for any researcher. This is because the choice of a particular model can have a great impact on the result of the estimates. The handful of studies that employed the stochastic frontier analysis in investigating the efficiency of government spending specified the Cobb-Douglas production function for instance Feeny et al (2008). The Cobb-Douglas production function is a particular functional form of the

production function widely used to represent the amount of output that two or more inputs can be used. This functional form is widely used because it is flexible, the interpretations of estimated coefficients are easy to make and it does not impose strict restriction. However it is criticized as being too simplistic as it assumes that all producers have the same production elasticities and that the substitution elasticity is equal to 1. Beside the Cobb-Douglas production function, a number of different functional forms are used in literature to model production functions. These include the quadratic, the normalised quadratic and the translog production functions. Quite a large number of studies on efficiency, especially in the field of agriculture employ the translog production function. The reasons are that this functional form does not impose restrictions on the elasticities of substitution. It also allows for the use of several input factors. However, it has a problem of the interpretation of the cross terms. In this study, we specify both the Cobb-Douglas and the Translog functional forms.

This study employs the stochastic frontier approach to measure public sector efficiency in the ECOWAS sub-region. Due to data constraints, we concentrate on the two major sectors in the sub-region; education and health. These two sectors, however, form a very large proportion of government expenditure. Primary and secondary enrolment is the outcome for education expenditure and life expectancy is the outcome for health expenditure. These are universally accepted as measures for well-being and represent components of the UNDP's Human development index. In addition, data for the measure are more widely available than the other measures (Simon and Rogers, 2008). The outcome in a country 'i' at time 't' is given by  $Y_{it} = f(inputs)$ . The inputs here are the health and education public expenditures.

Assuming technical efficiency, the actual observable outcome of health and education expenditures in each country  $i$  at time  $t$  is described by the following stochastic production functions:

$$Y_{it} = f(\text{inputs}, \beta) TE_{it} \ell^{v_{it}} ; \text{ where } TE = \ell^{U_{it}}$$

In logarithms, we have

$$\ln Y_{it} = \ln f(\text{inputs}, \beta) + v_{it} - u_{it},$$

Where  $-U_{it} > 0$ , but  $U_{it}$  may take any value and is assumed to be half-normal distribution. When we apply the translog specification we obtain the equation below,

$$\begin{aligned} \ln Y_{it} &= \beta_0 + \sum_{i=1}^n \beta_i \ln X_{it} + \beta_i \ln X_{it} + 1/2 \sum_{i=1}^n \sum_{j=1}^n \beta_{ij} \ln X_{it} \ln X_{jt} + V_{it} - U_{it} \\ \ln Y_{it} &= \beta_0 + \sum_{i=1}^3 \beta_i \ln X_{it} + \beta_i \ln X_{it} + 1/2 \sum_{i=1}^3 \sum_{j=1}^3 \beta_{ij} \ln X_{it} \ln X_{jt} + V_{it} - U_{it} \end{aligned}$$

The alternative Cobb Douglas Stochastic frontier production function can also be specified as

$$\begin{aligned} \ln Y_{it} &= \beta_0 + \sum_{i=1}^3 \beta_i \ln X_{it} + \varepsilon_{it} \quad \text{where} \\ \varepsilon_{it} &= v_{it} - u_{it} \end{aligned}$$

$$\ln Y_{it} = \beta_0 + \sum_{i=1}^3 \beta_i \ln X_{it} + v_{it} - u_{it}$$

For convenience, the translog and Cobb Douglas production function above can be written as

$$Y_{it} = \alpha + \beta^i X_{it} + v_{it} - u_{it}$$

Where  $Y_{it}$  represents a health or education outcome of a country  $i$ , at time  $t$ .

Specifically,  $Y_{it}$  represents infant mortality rate, life expectancy, primary or secondary school enrolment.

$$\beta_1 = \text{vector of parameters to be estimated}$$

$$V_{it} = \text{random errors}$$

$U_{it}$  = the inefficiency term

$X_{it}$  = vector of input variables and these include

$X_1$  = public health or education expenditure (PEH or PEE)

$X_2$  = per capita income (GDP)

$X_3$  = urbanization ( UPB)

The above will give us a production frontier to compute inefficiencies. We apply the Battese and Coelli (1995) time decay model to give us

$$U_{it} = U_i \times \exp \left[ -\eta(t - T) \right]$$

$$V_{it} \sim \text{iid } N(0, \delta_v^2) \quad U_{it} \sim \text{iid } N(0, \delta_u^2)$$

The inefficient term is, therefore, given as

$$U_{it} = \delta Z_{it} + \eta_{it}; \text{ or}$$

$$U_{it} = \delta_o + \delta_1 Z_{1t} + \delta_2 Z_{2t} + \dots + \delta_i Z_{it} + v_{it} - u_{it}$$

where;

$Z_{it}$  = the determinants of efficiency. These include;

$Z_1$  = inflation rate (INF)

$Z_2$  = population (POP)

$Z_3$  = political stability index (PS)

$Z_4$  = control of corruption (CC)

$Z_5$  = rule of law

The Battese and Coelli (1995) time decay model stated above will help us achieve the second, third and fourth objectives. That is computing the inefficiencies, comparing these efficiencies and also examining their determinants.

#### 4.5 Fixed Effect and Random Effect models

With regards to the first objective, that is examining the relationship between government spending and outcomes in health and education we employ panel regression. Life expectancy and primary enrolment are the dependent variables for health and education respectively, while the explanatory variables include public expenditure per capita income, urbanization, governance and inflation. Since the panel data is across country overtime, we intend running panel regressions for both the fixed effect and the random effect models. We then conduct the Hausman test in order to determine the preferred model. A major motivation for using panel data is that it allows one to control for unobserved heterogeneity. The idea is that countries have some unique characteristics that need to be taken care of to avoid endogeneity.

Using Fixed Effect implies one is interested in the impact of variables that vary over time. Fixed effect explores the link between the predictor and the outcome variables within an entity. We assume that the time-invariant characteristics are unique to the individual and must not be correlated with other individual characteristics. In effect, the fixed effect models controls for all time-variant differences between the individual countries so the estimated coefficient of the fixed effect models cannot be biased because of omitted time-invariant characteristics.

We can then specify our Fixed effect model as

$$y_{it} = X_{it}\beta + \alpha_i + u_{it}$$

Where;

$Y_{it}$  = the dependent variable observed for country I at time t.

Y here is life expectancy (LE) or primary enrolment (PE)

$X_{it}$  = time variant  $1 \times K$  regressor matrix or the independent variable. These include per capita GDP, public expenditure on education, population(POP), government index (GOV), and urbanization(UPB).

$\alpha_i$  = the unobserved time- invariant individual effect.

$U_{it}$  = error term

It is important to note that  $\alpha_i$  is not observable and hence cannot be controlled for  $\alpha_i$  is then eliminated by demeaning the variables using the within transformation as shown below.

$$y_{it} - \bar{y}_i = (X_{it} - \bar{X}_i) \beta + (\alpha_i - \bar{\alpha}_i) + (u_{it} - \bar{u}_i) \implies \ddot{y}_{it} = \ddot{X}_{it} \beta + \ddot{u}_{it}$$

$\alpha_i$  is a constant so  $\bar{\alpha}_i = \alpha_i$  the effect hereby eliminated.

The FE estimator  $\beta_{FE}$  is then obtained by an OLS regression of  $\ddot{y}$  on  $\ddot{X}$ .

We estimate the fixed effect model using stata with the command xtreg with fe options.

Random effect model, on the other hand assumes that variation across entities is random and not correlated with the predictor or the independent variables in the model. Using the random effect implies that one has reason to believe that differences across entities have some influence on the dependent variable. Green (2008) suggests that the distinction between the fixed and the random effect is whether the unobserved individual embodies elements that are correlated with the regressors in the model.

The random effect model helps in controlling for unobserved heterogeneity which is constant from data through differencing. Random effects assume that the entity's error term is not correlated with the predictors. We can specify the random effect model as

$$Y_{it} = \beta X_{it} + \alpha + u_{it} + \varepsilon_{it}$$

A random effect model can be estimated using Generalized Least Squares (GLS). Using stata, we estimate the random effects model using the command Xtnl and the option re. The problem with the random effect model is that some of the variables may not be available and hence leading to omitted variable bias in the model. In order to decide between the random and the fixed effect, we intend running a Hausman test. This test basically tests whether the error terms are correlated with the regressors. The null hypothesis states that there are no correlation and the alternate hypothesis states that there is.

In other words, the null hypothesis states that the preferred model is the random effects and the alternative the fixed effect (Greene, 2008.).

We will have to run a fixed effect model for primary enrolment, save the estimates and then run a random effect model for the same primary enrolment and save the estimates. We will then perform the Hausman test.

#### **4.6 Variable description and expected sign.**

The study employs a secondary data for all of its analysis and subsequent discussions. A panel data for 15 countries in the ECOWAS sub-region over the period 2002 to 2011 is used, and the data is sourced from the World Development Indicators (2014).

In the first stage, health and education expenditure are included separately as explanatory variables. The objective here is to investigate if an extra public spending has any impact on health and education outcomes. These variables are expressed as a ratio to GDP in the respective countries. We expect a positive relationship between government spending in education and gross primary and secondary school enrolments. We also expect a negative relationship between public health spending and life expectancy. This is because, increasing government spending in the two

sectors should result into expansion of facilities and the provision of various infrastructure hence increasing school enrolments and reducing life expectancy. In addition, we include other variable that have positive impact on social outcomes but which are outside the control of the recipient countries. These variables are per capita income and urbanisation.

A country's per capita income is included as an explanatory variable because those with higher incomes are likely to experience better health outcomes through better nutrition, housing and sanitation. In addition, those in high income bracket are able to provide better and quality education for their wards and dependants compared to those of lower incomes. We, therefore, expect per capita income to have a positive impact on school enrolments and a negative impact on life expectancy.

Urbanization refers to the percentage of the total population that lives in urban centres. Cities can be tremendously efficient. It is much easier to provide water and sanitation to people living closer together, while access to health, education, and other social and cultural services is also much more readily available. It is also included as an explanatory variable because of the likely that countries that are more urbanized have a higher probability of having improved and quality access to health services and education (Feeny and Rogers 2003). We, therefore, expect urbanization to have a positive impact on primary enrolment and secondary enrolments and a negative impact on life expectancy.

In order to examine the determinants of efficiency of public spending, variables that may have an impact on the relationship between input and output in the health and education sectors are included as explanatory variables. They include a macroeconomic index, i.e. inflation, governance index and a population variable.

Inflation can be defined as the sustained increase the general prices of goods and services in an economy in a period of time. The rate of inflation is a reflection of a reduction in the purchasing power of money in an economy. High rates of inflation imply that the medium of exchange in the economy has lost its value hence less goods and services are available to the ordinary consumer. The economies that are doing well and are very efficient should have lower rates of inflation. We therefore expect inflation to have a positive impact on inefficiency and hence a positive sign.

Governance index is sourced from Worldwide Governance Indicators and it is disintegrated into three distinct parts i.e. rule of law, control of corruption and political stability and no violence. The Rule of Law index reflects perceptions of the extent to which people have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. We believe that countries that respect rule of law will be more efficient. The expected sign is therefore negative.

Control of Corruption index reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Several studies have demonstrated a positive impact of corruption on inefficiency. Corruption leads to mismanagement of state resources, problems of accountability and transparency to the public, depletion of the nation's wealth, conversion of public resources into private hands, gross inefficiencies and many others. Higher levels of the Control of Corruption index imply corruption is minimal and hence lower levels of inefficiency. We therefore expect a negative sign.

Political Stability and absence of violence variable reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. We expect a negative sign because countries the lack violence and are politically stable are more likely to reduce inefficiency.

Finally, we include population variable to investigate the relationship between population size and efficiency. The purpose is to tell whether population size has any impact on efficiency in these countries. We expect both positive and negative signs. Table 4.1 presents a summary of the variables used in the models with their expected signs:

**Table 4.1:** Variables and Expected Signs

<b>Variables</b>	<b>Expected Sign</b>
Frontier:	
Public Health Expenditure	Positive (+)
Public Education Expenditure	Positive (+)
Per Capita GDP	Positive (+)
Inefficiency model:	
Population	Positive/Negative (+/-)
Inflation	Positive (+)
Rule of Law	Negative (-)
Control of corruption	Negative (-)
Political stability	Negative (-)

#### **4.7 Source of data.**

Data is sourced from both World Development Indicators (WDI) and the Worldwide Governance Indicators (WGI). WDI is an initiative of the World Bank with the primary objective of collecting development indicators from officially-recognized international sources. It presents the most current and accurate global development data available, and includes national, regional and global estimates. It is a time series data that covers a wide range of areas including Agriculture & Rural Development, Aid Effectiveness, Climate Change, Economy & Growth, Education, Energy & Mining, Environment, External Debt, Financial Sector, Gender, Health, Infrastructure, Labour & Social Protection, Poverty, Private Sector, Public Sector, Science & Technology, Social Development, Trade and Urban Development ([www.worldbank.org](http://www.worldbank.org)).

WGI is also a World Bank Group initiative. The Worldwide Governance Indicators (WGI) are a research dataset summarizing the views on the quality of governance provided by a large number of enterprise, citizen and expert survey respondents in industrial and developing countries. These data are gathered from a number of survey institutes, think tanks, non-governmental organizations, international organizations, and private sector firms. The Worldwide Governance Indicators project conducts aggregate indicators six dimensions. These include Control of Corruption, Rule of Law, Regulatory Quality, Government Effectiveness, Voice and Accountability and Political Stability and Absence of Violence/Terrorism ([www.govindicators.org](http://www.govindicators.org)).

**Table 4. 2;** Summary of variables, description and sources

<b>VARIABLE</b>	<b>DESCRIPTION</b>	<b>SOURCE</b>
Public Health Expenditure(PEH)	Ratio of public health expenditures to GDP	WDI
Public Education Expenditure(PEE)	Ratio of total public sector education expenditures to GDP	WDI
Per capita income(GDP)	Real GDP per capita	WDI
Population (POP)	Total population of a country	WDI
Governance	CC, ROL, PS	WGI

## CHAPTER FIVE

### DATA ANALYSIS AND DISCUSSIONS

#### 5.1 Introduction

This chapter presents the findings of the study. The chapter is sub-divided into two parts. Part one begins with the presentation and discussion of the summary statistics characteristics. The second part discusses the empirical results obtained from the study.

#### 5.2 Summary statistics of data.

As mentioned in the previous chapter, this study uses secondary data. It employs panel data from 2002 to 2011 for the fifteen ECOWAS countries. Table 5.1 shows a summary of the data regarding country specific mean values of health and education expenditure and their outcomes used in the estimation. For life expectancy and infant mortality rate, a total of 125 and 136 observations were available respectively. Guinea-Bissau has the highest life expectancy mean of 74 years the lowest of 48 is for Sierra Leone. The average for the region for the period is 58. For infant mortality rate, Sierra Leone has the highest of 130 and Cape Verde has the lowest of just 23. The region's average is 76.

Cape Verde and Togo record high school enrolments. The average for the region is 82 and 36 for primary and secondary enrolments respectively. We had a serious challenge with data for SE where only 86 observations were available out of the 150 samples. The average public expenditure for education and health in the sub – region is 8.4 and 3.8 as a percentage of GDP respectively. These are shown in tables 5.1 and 5.2.

**Table 5. 1:** Country specific mean of variables

COUNTRY	LIFE EXPECTANCY	PRIMARY ENROLMENT	SECONDARY ENROLMENT	INFANT MORTALITY RATE	PUBLIC SPENDING - EDUCATION	PUBLIC SPENDING- HEALTH
Benin	57.6	105.7	32.5	71.9	2.2	4.0
Burkina Faso	55	77.1	16.6	81.1	2.8	4.3
Cape Verde	72.4	114.2	79.6	23.0	3.5	5.8
Cote D'Ivoire	48.1	79.6	-	87.0	1.7	4.4
Gambia	57.2	89.2	58.1	54.4	2.3	2.2
Ghana	63.9	77.6	50.0	56.0	11.1	6.0
Guinea	69.1	45.8	28.8	80.1	27.9	1.9
Guinea B	74.1	30.1	33.4	92.3	32.4	1.6
Liberia	56.5	97.0	45.2	77.7	2.4	3.9
Mali	52.2	82.9	33.5	93.5	3.0	4.2
Niger	54.9	53.9	10.9	78.3	7.2	3.6
Nigeria	49.5	93.4	35.3	92.5	6.2	-
Senegal	61.2	80.7	27.5	54.5	5.1	4.6
Sierra L	48.3	84.2	-	130.3	12.0	3.6
Togo	54.6	119.1	43.1	69.9	6.5	3.9
Total	57.9	81.8	36.9	76.2	8.4	3.8

Source: Author's computation using Stata 13

Table 5.2 shows the summary statistics of the various variables used in the estimation. It gives the mean values, the standard deviation, the minimum and the maximum values of public expenditure in education and health and their various outcomes in the sub region.

**Table 5.2:** Summary statistics of government spending and outcomes

VARIABLE	NO. OF OBSERVATION	MEAN	STD. DEV.	MIN	MAX
PUBLIC SPENDING ON EDUCATION	107	3.832229	1.462731	1.0345	7.53558
PUBLIC SPENDING ON HEALTH	149	8.435153	14.03219	1.1	16.9
LIFE EXPECTANCY	146	57.85755	11.91275	39.64663	119.9187
PPRIMARY ENROLMENT	128	81.75736	31.0748	2.13637	131.4211
INFLATION	150	61.15529	205.9323	-9.823833	103.1
GDP PER CAPITA	150	698.013	708.5095	33.6942	3801.45
URBANIZATION	150	741982.4	3376557	16.4044	2.48e+07
POPULATION	150		3.51e+07	459140	164162925
GOVERNANCE	142	30.30901	16.06198	2.43837	67.31

### 5.3 Analysis of the Econometric Results

This study employed the Stata computer software to estimate the models. In order to explore the link between government spending and the explanatory variables, we began by running both fixed and random panel regression. This is the first objective of the study. Table 5.2 and 5.3 present the results of the fixed effect regression for primary enrolment. The results indicate that GDP per capita, population, governance index and inflation all have a positive impact on primary enrolment. All the explanatory variables are jointly significant at 5% level of significance in both regressions. The governance index and the inflation rate are not statistically significant in both the random and fixed effect regression. The variable for urbanization (UPB) was dropped due to collinearity. Interestingly, public education

spending has a negative impact on primary enrolment and it is not statistically significant at 5% level of significance. This weak link between public expenditure spending and primary school enrolment is supported by Al-Samarrai (2003) in case studies on Botswana, Malawi and Uganda. The reason given for this finding was that per pupil expenditure declined as access was increasing. In addition, Malawi and Uganda was experiencing negative relationship between spending and access. Anand and Ravallion (1993) also find no significant relationship between public spending on education and education outcomes. Other findings, however, contrasts these results. For instance, while McMahon (1999) finds a negative but significant relationship, others like Filmer and Pritchett (1997), Baldacci et al (2003), Bidan and Ravallion and others support positive effects of education spending and outcomes. In order to identify the preferred model, a Hausman test is administered. The Hausman test checks a more efficient model against a less efficient but consistent model to make sure that the more efficient model also gives consistent results. The results are given in table 5.4 below.

**Table 5. 3;** Random-effect GLS regression showing relationship between primary enrolment and other variables

Variables	Parameter	Coefficient	z	p>z
cons	$\beta_0$	1.431172 (.2832167)	5.05	0.000
Ln Public Education Exp	$\beta_1$	-.042558 (.065623)	-0.65	0.517
Ln GDP per capita	$\beta_2$	.2605145 (.0575258)	4.53	0.000
Ln Population	$\beta_3$	.0768635 (.0171418)	4.48	0.000
Ln Governance	$\beta_4$	.0622117 (.1001637)	0.62	0.535

**Table 5.3 Fixed-effect (within) regression for primary enrolment**

Variables	Parameter	Coefficient	t	p>t
Constant	$\beta_0$	1.354727 (.3561241)	3.80	0.000
Ln Public Education Exp	$\beta_1$	-.0345119 (.0701707)	-0.49	0.625
Ln GDP per capita	$\beta_2$	.2773317 (.0246187)	4.05	0.000
Ln Population	$\beta_3$	.0724796 (.0246187)	2.95	0.005
Ln Governance	$\beta_4$	.0012643 (.1412196)	0.51	0.610
Ln Inflation	$\beta_5$	.0012643 (.0200004)	0.06	0.950

**Table 5. 4;** Hausman test

<b>Variable</b>	<b>Fixed1</b>	<b>Random1</b>	<b>Difference</b>	<b>S.E.</b>
Ln Public Education Expenditure	-.0345119	-.0425585	.0080466	.0248505
Ln GDP per capita	.2773317	.2605145	.0168171	.0371654
Ln Population	.072568	.0768635	-.0042965	.0176703
Ln Governance	.0724796	.0622117	.0102679	.0995501
Ln Inflation	.0012643	.0017249	-.004606	.0063461

Source: Author's computation using Stata 13.0

We test for the null hypothesis (Ho) that difference in coefficients is not systematic. Since  $\text{Prob}>\chi^2 = 0.9936$  which is greater than 0.05 (i.e. the significant level), the random effect model is preferred. The implication is that differences across countries in the sub – region have a significant influence on primary enrolment.

Similarly, we ran a panel regression to explore the link between life expectancy and public expenditure on health, governance index and other variables. The results are presented in table 5.5 below.

**Table 5. 5:** Panel Regression for life expectancy

Variables	Parameter	Coefficient	t	p>t
Constant	$\beta_0$	4.174936 (.0735189)	56.79	0.000
Ln Public Expenditure on health	$\beta_1$	.006187 (.0105239)	0.59	0.558
Ln GDP per capita	$\beta_2$	.0464307 (.0128842)	3.60	0.000
Ln Population	$\beta_3$	-.0431343 (.0037099)	-11.63	0.000
Ln Governance	$\beta_4$	.0653095 (.0131392)	4.97	0.000
Ln Inflation	$\beta_5$	.002332 (.0059004)	0.40	0.693

The results show R-squared and the critical value of the F-statistics to be 0.606 and 0.000. This implies that all the explanatory variables; public health expenditure, GDP per capita, urbanization, population size, governance and inflation are jointly significant and well explain life expectancy. Though the impact of government spending on life expectancy is positive, it is statistically not significant since its t-statistics gives a value of 0.558 which is less than 0.05 at 5% level of significance. Per capita income and governance have a positive and significant impact on life expectancy. Urbanization was dropped because collinearity and inflation rate is positive but not statistically significant. Population size has a negative effect on life expectancy and it is statistically significant. The results imply that governments in the sub-region should not only be increasing their spending but also consider other equally important factors like per capita income, population growth rate and

governance. The impact of per capita income will be discussed more during the analysis of the frontier results.

Governance index, as stated in chapter 4, is made up of six equally weighted indicators of worldwide governance. They include rule of law, government effectiveness, control of corruption, voice and accountability, political stability and regulatory quality. Improving upon the quality of governance will lead to improvements in life expectancy rates through avoidance of waste, implementation of good policies and ensuring efficiency in the sector.

#### **5.4 Stochastic frontier analysis and technical efficiency estimates**

The second objective of the study is to estimate the efficiency of government spending. The stochastic frontier analysis was employed in this regard because of its advantage over other methods of efficiency measurement. This methodology also enabled us to achieve the third and fourth objective by exploiting the Battese and Coelli (1995) model. First of all, we estimated the efficiency of public health spending on infant mortality rate in the ECOWAS sub – region using maximum likelihood methods. This method is said to be more efficient than the corrected ordinary least square (Bravo-Ureta et al, 1993). The results are presented in table 5.7.

**Table 5. 6:** Maximum likelihood Estimates of variables showing Efficiency of Public Spending on Infant Mortality rate

Variable	Parameters	Coefficient	Standard Error	P> Z
<b>Frontier Function</b>				
lnPublic Health Spending(LPEH)	$\beta_1$	-0.0225787	0.0111427	0.043
ln GDP per capita (lnGDP)	$\beta_2$	-0.0393779	0.0166525	0.018
Constant	$\beta_0$	43.78334		
<b>Efficiency model</b>				
ln Inflation (lnINF)	$\delta_1$	-0.0092925	0.003501	0.018
ln Political Stability (lnPS)	$\delta_2$	-0.0393779	0.006715	0.003
ln Control of Corruption (lnCC)	$\delta_3$	-0.025436	0.0085808	0.003
Year (T)		-0.0191075	0.0003151	0.000
<b>Variance Parameters</b>				
sigma2		0.1334446	0.088974	
Gamma		0.991475	0.0056028	
sigma_u2		0.0056028	0.0889481	
sigma_v2		0.0011376	0.0001526	

Source: Author's computation using Stata 13

It is evident from the results that the estimate of gamma,  $\gamma$  which is the ratio of country specific technical efficiency to the total variance of output is 0.991475 for infant mortality. This value is very close to 1. This implies that for countries in the sub-region, the greater percentage of the variation in the error term is due to the inefficiency error ( $U_{it}$ ) and not the random error,  $V_{it}$ . The random component of the inefficiency effects does not make significant contribution to the analysis. Frontier results from table shows that public health spending has a negative impact on infant

mortality rate and it is statistically significant at 5% level of significance. The implication is that if government increase their spending in health, it will make more healthcare service more readily available and hence a reduction in infant mortality rates. This result is supported by other studies like Yaqub et al (2012). The elasticity of public health spending is -0.0225785. This implies that 1 percent increase in public health spending will lead to 0.2 percent fall in infant mortality rate. GDP per capita also has a negative and significant impact on IMR with an elasticity of 0.03. Its impact is even stronger than that of PEH. This suggests that improvements in health outcomes require more than just budgetary allocations. Quite a number of studies also found similar results. For instance, Gupta and Verhoeven (1999), Savas and Okan (2013) and Filmer and Pritchett (1997). The technical efficiency estimates are presented and explained in section 5.3.3

As stated earlier the computer software, Stata is employed in the estimation. Xtfreedom command enables us to exploit the Battese and Coeli time varying decay model. The results for secondary and primary enrolments estimated using maximum likelihood are presented in Table 5.7 and 5.8 respectively.

**Table 5. 7:** Maximum Likelihood Estimates showing efficiency of Public Education Expenditure on Secondary Enrolment

Variable	Parameters	Coef.	Std. Err.	P> z
<b>Production Frontier</b>				
_cons	$\beta_0$	13.8016	.	
Ln Public Spending on educ.	$\beta_1$	.0419938	.0546348	0.442
Ln Per Capita GDP	$\beta_2$	.1123572	.0460114	0.015
<b>Efficiency Model</b>				
Ln Population	$\delta_1$	-.0182231	.0113168	0.107
Ln Political stability	$\delta_2$	.0011621	.0218072	0.958
Ln Control of corruption	$\delta_3$	-.1126071	.0245667	0.000
YEAR	$\delta_4$	.0092155	.000213	0.000
<b>Variance Parameters</b>				
sigma2		.2153524	.0979958	
Gamma		.9892637	.0054785	
sigma_u2		.2130404	.098022	
sigma_v2		.0023121	.0004821	

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Source: Author's computation using Stata 13

**Table 5. 8:** Maximum Likelihood Estimates showing efficiency of Public Education Expenditure on Primary Enrolment

Variable	Parameters	Coefficient	Std. Err	P> z
<b>Production Frontier</b>				
_cons	$\beta_0$	103.4524	40.78368	
Ln Public spending on educ.	$\beta_1$	.1721431	.1541091	0.264
Ln Per Capita GDP	$\beta_2$	.6037283	.0717415	0.000
<b>Efficiency Model</b>				
Ln Rule of Law	$\delta_1$	.6573681	.1602998	0.000
Ln Control of Corruption	$\delta_2$	-.5625907	.1741771	0.001
Ln Political Stability	$\delta_3$	-.2919478	.1113135	0.009
Year	$\delta_4$	-.0510479	.0203032	0.012
<b>Variance Parameters</b>				
sigma2		.9981576	1.430841	
Gamma		.9739415	0.374482	
sigma_u2		.9721471	1.430677	
sigma_v2		.0260105	.0044426	

Source: Author's computation using Stata 13

Results show evidence of inefficiency in both models. The estimates of gamma,  $\gamma$ , for both primary and secondary enrolment are 0.97 and 0.9892 respectively. These values indicate that for both SE and PE the greater percentage of error variation is due to the inefficiency term,  $U_{it}$ , and not the random variable,  $V_{it}$ . This also implies the random variable does not make any significant contribution to the analysis. In both results, all the parameters are jointly significant. In addition, the effect of public education expenditure on primary and secondary enrolment is statistically not significant at 10%

level of significance even though the coefficients are positive. GDP per capita has a great impact on both PE and SE. the elasticity of per capita GDP as far as PE is concerned is 0.60. The implication is that if per capita GDP increases by 1%, Primary enrolment increases by 0.6%. These results just emphasize earlier results that governments should look beyond budgetary allocation if they want to improve upon social outcomes. Similar finding on the impact of GDP per capita on education outcomes exist in literature. Examples are Anyawu and Erhijakpor (2007).

#### **5.4.1 Technical efficiency estimates**

With respect to the second and third objectives, Table 5.9 presents the mean technical efficiency estimates for both public health expenditure and public education expenditure for the 15 countries in the sub-region. Each country's estimate represents the mean of the technical efficiency estimates for the ten year period. It can be observed from the table that, Cape Verde has the highest efficiency score in Public Spending in education and in health (i.e. 82% and 88% respectively). Sierra Leone had the lowest estimates in PEE (23%) while Liberia had the lowest in PEH. From table 5.9, the estimates technical efficiency of public spending on primary enrolment ranges from 0.23 to 0.88 with a mean of 0.59. In the same way, that on infant mortality ranges from 0.17 to 0.87. This implies that countries in the ECOWAS sub-region are operating at efficiency levels of 59% for the health sector and 52% for the education sector. This means that IMR could be increased by 41% and PE by 48% if resources were efficiently used without the use of any additional resources. In other words, countries in the sub-region have the potential to improve upon their health and education outcomes without incurring further cost. Table 5.9 and 5.10 provide the mean distribution of technical efficiency estimates for government spending in education in the ECOWAS sub-region.

**Table 5. 9: Technical Efficiency estimates**

<b>COUNTRIES</b>	<b>EDUCATION (Primary Enrolment)</b>	<b>HEALTH (Infant Mortality Rate)</b>
Benin	0.6263	0.4012
Burkina Faso	0.5047	0.4172
Cape Verde	0.8181	0.7496
Cote D'Ivoire	0.5087	0.7826
Gambia	0.8779	0.3123
Ghana	0.8089	0.7234
Guinea	0.6016	0.3733
Guinea Bissau	0.4294	0.6475
Liberia	0.6649	0.1645
Mali	0.3419	0.4203
Niger	0.5456	0.5245
Nigeria	0.3675	0.5012
Senegal	0.8530	0.5707
Sierra Leone	0.2280	0.5297
Togo	0.6634	0.4436

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Source: Author's calculation

**Table 5. 10: Distribution of technical efficiency of public spending in education**

Technical efficiency	Frequency	Percentage (%)
0.10 – 0.20	1	6.67
0.21 – 0.30	0	0.00
0.31 – 0.40	3	20.00
0.41 - 0.50	4	26.67
0.51 – 0.60	2	13.33
0.61 – 0.70	1	6.67
0.71 – 0.80	3	20.00
0.81 – 0.90	1	6.67
0.91 – 1.00	0	0.00
Total	15	100.00

Author's calculation using Stata 13

**Table 5. 11: Distribution of technical efficiency estimates of government spending on health**

Technical efficiency	Frequency	Percentage (%)
0.10-0.20	0	0.00
0.21-0.30	1	6.67
0.31-0.40	2	13.33
0.41-0.50	2	13.33
0.51-0.60	3	20.00
0.61-0.70	3	20.00
0.71-0.80	0	0.00
0.81-0.90	4	26.67
0.91-1.00	0	0.00
Total	15	100.00

Source: Author's calculation using Stata 13

It is important to note that seven countries, Benin, Cape Verde, Gambia, Ghana, Liberia, Senegal and Togo operate above the average efficiency estimates of 58% in terms of primary enrolment and therefore can be said to be more efficient. For the health sector, the more efficient countries are Senegal, Niger, Guinea, Ghana, Cote d'Ivoire and Cape Verde. The levels of efficiencies in the ECOWAS sub-region are very low as compared to those of other regions. There is, therefore, much cause for concern for policy makers to take action to improve upon these efficiency levels.

#### **5.4.2 Determinants of efficiency of government spending.**

The last objective relates to exploring governance and institutional factors that determine the efficiency of government expenditure. The estimates of technical efficiency provide much insight with regards to factors that affect technical efficiency. Except for the parameter of the rule of law, all the other parameters have the relevant signs and they are statistically significant. From tables 5.6, 5.7 and 5.8, the Control of corruption (CC) index has a significant negative impact on inefficiency in both health and education. The implication is that countries in which we have higher levels of CC, efficiency is high and vice versa. Control of corruption (CC) is a variable included in all models to estimate the impact of corruption on technical inefficiency. In other words, the higher the CC, the lower the inefficiency and the greater the efficiency. The expectation is supported by the highly significant estimated coefficient for this variable in the PE, SE, LE and the IMR model.

This result is supported by Mauro (1998) who shows that corruption reduces the impact of government spending on education. Delavallade (2006) also finds out that high level of corruption on social outcomes in developing countries. Ablo and Reinikka (1998) carried out a research that shows that only 30% of the expenditure per pupil reached the targeted primary schools in Uganda between 1991 and 1995. The variable political stability (PS) has a negative effect on technical inefficiency of government spending on immortality rate. This implies that countries which have experienced political stability and less violence in the past ten years are more likely to be efficient in reducing infant mortality rates.

Political stability also has a positive effect on the efficiency of government expenditure in reducing IMR and also increasing primary enrolment. This finding is

supported by Sok-Gee and Karim (2012) who also discovers that political stability has a positive and financial freedom have a positive effect on the efficiency of public spending. Rule of law (ROL) is a variable included to find out if it will have any impact on efficiency in the sub-region. Surprisingly, the results indicate a negative and significant relationship between rule of law and the efficiency of government spending in education. Finally, year variable is included in each of the four models to investigate the effect of technological changes on efficiency. The coefficient of the year variable is statistically significant at 1 percent level of significance in each of the models. The implication is that technological changes helped in improving life expectancy, reducing infant mortality rates and increasing both primary and secondary enrolment,

## **CHAPTER SIX**

### **SUMMARY OF FINDINGS, CONCLUSION AND POLICY**

#### **RECOMMENDATIONS**

##### **6.1 Introduction**

This chapter concludes the study by providing a summary for the entire study. The findings and results of the study are also summarized in this chapter. These findings serve as basis upon which recommendations have been made for policy makers to consider. Limitations of this study have also been outlined in this chapter and the final section of the study gives recommendations for future research.

##### **6.2 Summary of Findings**

The main issues addressed in this study were first to examine the relationship between government expenditure in health and education and outcomes in the sub – region. Secondly, we sought to estimate the efficiency of government expenditure in the health and education sectors. We then did a comparison of the efficiency of government expenditure among countries in the ECOWAS sub-region in education and health. Our last objective was to explore the factors that were most important in explaining the variation in this efficiency of countries at achieving outcomes.

Efficiency is important in every sphere of life. Efficiency is about trying to do more for less. It involves maximizing outputs such as the volume of services provided from a given set of inputs, minimizing inputs such as the amount of resources or capital required to produce those services and also attempting to maintain or improving quality. Efficiency can be measured by how much it costs to provide a service or a product compared to previous years or compared to peers, or the relative outcomes that governments obtain from a certain level of expenditure.

Governments all over the world spend a significant proportion of their GDP in providing social services in order to improve upon the standard of living of their citizens. The desire to achieve the millennium Development Goals has even caused most countries to increase their spending, especially, in the social service sectors. Countries in the ECOWAS sub – region have not been left behind in this drive. However, with efficiency, governments could still improve upon their social outcomes without increasing their spending. This study, therefore, sought to examine the efficiency of government expenditure in education and health sectors of countries in the ECOWAS sub – region.

The ECOWAS sub-region has seen the life expectancy of its population reduced by communicable and parasitical diseases that have mostly been eliminated in the developed countries. The sub-region is also experiencing increasing rates of the non-communicable lifestyle diseases which have become killers in the developed nations. Many countries in the sub-region are still not able to provide basic sanitation, clean water and adequate balanced diet to their citizens let alone deal with the onset of these diseases. The member countries have poor infrastructure, shortage in professionals, ethnic conflicts and a whole lot of problems that hamper health delivery. In addition, some of the world's worst indicators of health in life expectancy, maternal mortality and infant mortality in the ECOWAS sub – region. Despite the huge investments in education, this study also reveals that the sub – region records the worst literacy rates worldwide.

The Cobb-Douglass production function was specified, since it is easier to use and interpret as compared to the translog production function. Results indicate that whiles

public spending on health has a positive and significant impact on infant mortality rate, that on education also has a positive impact on primary enrolment but it is not statistically significant. Per capita GDP has a greater impact on infant mortality rates and primary enrolment than the public expenditure.

The results on technical efficiency also indicate that efficiency of government spending is very low in the sub-region and this should be a major concern for governments in the sub region. According to the findings, countries in the sub region are operating at efficiency levels of 59% for the health sector and 52% for the education sector. This study also identified Cape Verde as the most efficient country as far as public expenditure in health and education is concerned. Finally, control of corruption, rule of law, political stability and technological progress were also identified as the main determinants of efficiency in the two sectors.

### **6.3 Conclusions**

This study employed the SFA technique to measure the public sector efficiency. Separate frontiers were estimated for infant mortality rates, life expectancy and school enrolments. There is evidence that public sector efficiency is very low in the sub – region, i.e. 0.59 for the education sector and 0.52 for the health.

In conclusion, this study has demonstrated that increasing government spending in education and health sectors of countries in the ECOWAS sub region can lead to improvements in outcomes. This is, however, just a necessary condition but not sufficient. The sufficient condition is efficiency. Efficiency leads to less wastage and hence government spending can reach its target destination easily. Countries should therefore address issues of efficiency in addition to increasing spending in these two

sectors. Findings from this study demonstrate that efficiency alone can lead to over 40% improvement in outcomes. Efficiency must be taken seriously.

#### **6.4 Policy Recommendations**

On the basis of the findings, the following recommendations are made for policy considerations.

- Countries in the sub – region should endeavour to implement policies that ensure sustained political stability. A higher level of political stability will imply less political risk, less violence and an increase in public spending efficiency. One major way of ensuring political stability through economic development. Literature has demonstrated that economic development reduces discontent and enhances political stability. Sound economic policies that reduce unemployment rates, ensure stability in prices, guarantee stable power, reduce transport cost, construct good roads and enhance economic growth reduce agitations and violence. Policy makers should, therefore, priority to economic development in order to ensure political stability in the sub – region.
- In addition governments must do their possible best to control drastically the level of corruption. Public spending appears to have a negligible effect on school enrolment in highly corrupt regions, while it has a statistically significant, positive, and relatively large effect in less corrupt regions. In this study, public spending has no significant effect on school performance. The main lesson from this paper is that allocating more public funds to the education system is not likely to promote improvement if not accompanied by efforts to improve upon governance in the these sectors. Every effort must

be made to avoid waste in government spending. One way of achieving this is through press freedom. The press can contribute to control of corruption by keeping the electorate informed thereby serving as a check on fraud, embezzlement and other corrupt practices of other government officials. In addition, governments should stop covering up for corrupt government officials, but rather allow the institutions to work in order to ensure effective regulatory quality, rule of law and accountability.

- Per capita income has a strong positive impact on school enrolment, life expectancy and a negative impact on infant mortality rate. As such to increase households' preparedness to access health and education services, measures should be undertaken to increase the incomes of the households. Such measures may include increasing the national daily minimum wage so that incomes will go up significantly. Measures should also be undertaken to provide jobs for the unemployed. This way, the incomes of previously unemployed persons who now have jobs will add to their households' incomes to enhance willingness to access these services.
- Moreover, in order to meet the millennium development goals in education and health, more resources should be channeled into these sectors. The insignificance of the coefficient of public expenditure of education (PEE) on primary enrolment does not imply that more resources should not be into that sector. The coefficient of public health expenditure on infant mortality rate is positive and statistically significant. The implication is that allocating more resources to these sectors is necessary but not sufficient. Equal attention should be paid to efficiency and other important socio-economic variables discussed above. In addition, the direction of these spending should be

allocated into the provision of health and education infrastructure and all effort should be made so that these spending reach their target destination.

### **6.5 Recommendation for future research**

Having established the efficiency of government spending in education and health for the ECOWAS sub- region, it is recommended that future studies should concentrate on the efficiency of government spending in other sectors of the economies of ECOWAS member countries. Sectors like agriculture and manufacturing could be looked at. This will provide a more comprehensive view of government spending efficiency.

In addition, it will be interesting to relate efficiency to economic development. Hence future research can examine the impact of government efficiency on economic growth.

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