UNIVERSITY OF CAPE COAST

EFFICIENCY OF PUBLIC SPENDING ON HUMAN CAPITAL, PUBLIC DEBT AND INCOME INEQUALITY IN SELECTED AFRICAN COUNTRIES

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BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature…… Date……

Name: Isaiah Sikayena

Supervisors' Declaration

We hereby declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines on supervision of thesis as laid down by the University of Cape Coast.

Principal Supervisor's Signature……..… Date……

Name: Dr. Isaac Bentum-Ennin

Co-supervisor's Signature…….. Date……..……...

Name: Dr. Francis Kwaw Andoh

ABSTRACT

The study assessed the effect of public spending efficiency on human capital, public debt, and income inequality in Africa. Specifically, the study computed technical efficiency scores for public spending on education and health and examined its effect on public debt and income inequality. Data Envelopment Analysis and DEA Bootstrapping models were used to investigate the relative technical efficiencies and their correlates in Africa. System GMM was used to examine the relationship between public spending, public debt, and income inequality while Lind and Mehlum U-shaped test approach was used to determine the turning points. The data was sourced from the World Bank's World Development Indicators, World Governance Indicators, and Standardized World Income Inequality database from 2006 to 2017 for African countries. The study found public spending on health and education to be inefficient. The countries (DMUs) were found to be more efficient in health spending than in education spending. Factors such as government expenditure, economic growth, urbanization, trade openness, and institutional quality were found to influence efficiency of public spending on human capital. Institutional quality of at least 50% increases efficiency of public spending on education. Efficiency of public spending on health of at least 70.62% was found to reduce public debt while efficiency of public spending on education of at least 77.1% and 77.4% were found to reduce public debt and income inequality respectively. The study recommends that governments should ensure high levels of efficiency of public spending on human capital to reduce public debt and income inequality by ensuring institutional quality, trade openness, and growth in urbanization.

KEY WORDS

Human Capital

Income Inequality

Public Debt

Public Spending Efficiency

Technical Efficiency

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DEDICATION

To my late mother

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LIST OF ACRONYMS

AMCP	African Programme me for Monetary Cooperation Programme me
AR-Test	Arrelano and Bond Test of Autocorrelation
BMS	Broad Money Supply
CCR	Constant Returns to Scale
DEA	Data Envelopment Analysis
DMUs	Decision Making Units
DNSF	Deterministic Non-Statistical Frontier
FA	Frontier Approach
FDI	Foreign Direct Investment

FF	Frontier Function
GDP	Gross Domestic Product
GMM	Generalized Methods of Moments
GPSER	Gross Primary School Enrolment Ratio
GSSER	Gross Secondary School Enrolment Ratio
HIPC	Highly Indebted Poor Countries
IMF	International Monetary Fund
IMR	Infant Mortality Rate
IV	Instrumental Variable
LAC	Latin America Caribbean
LMIC	Lower and Middle Income Countries
MDGs	Millennium Development Goals
MDRI	Multilateral Debt Relief Initiative
MLE	Maximum Likelihood Estimates
MMR	Maternal Mortality Ratio
NFM	Non-Frontier Approach
OECD	Organization for Economic Co-Operation and Development
OLSA	Ordinary Least Square Approach
PA	Parametric Approach
PD	Public Debt
PISA	Programme me for International Students Assessments
PSE	Public Spending On Education
PSEE	Efficiency of Public Spending On Education
PSH	Public Spending On Health
SDG	Sustainable Development Goal

SFA	Stochastic Frontier Approach
SFM	Stochastic Frontier Model
SSA	Sub-Saharan Africa
SWIID	Standardized World Income Inequality Data
TFP	Total Factor Productivity
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
VRS	Variable Returns to Scale
WDI	World Development Indicators
WGI	World Governance Indicator
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

This chapter presents the background and the problem statement of the study. It also specifies the objectives and hypotheses that the study seeks to achieve. The scope and significance of the study are also presented in this chapter.

Background of the Study

Public spending on education and health in developing countries has attracted the attention of many economists, researchers, and policymakers because of its important role in building human capital for economic growth and development (Anaduaka, 2014; Chandra, 2022; Fahimi et al., 2018; Gebrehiwot, 2014; Ghosh & Parab, 2021; Suri et al., 2011), poverty reduction (Asaju, 2012; Cremin & Nakabugo, 2012; Okorie-Nathan, 2016) and promotion of the wellbeing of individuals (Currie, 2009). Human capital is an intangible asset that the labour force needs to improve productivity and wellbeing (Goldin, 2016). According to Schultz (1961) and Becker (1962), human capital is associated with knowledge and skills acquired through education, experience, and health care. Benos and Zotou (2014) defined human capital as a set of knowledge, skills, competencies, and abilities embodied in a person and acquired as a result of education, new learning, training, medical care, and experience.

The difficulty in measuring new learning and training calls for the use of education and health status as the common measure for human capital development in the literature (Ogundari & Abdulai, 2014; Ogundari & Awokuse, 2018). Education and health are significant components of human

capital since they have direct and indirect effects on productivity and economic growth. The use of education and health as a measure of human capital appeared in the works of Becker (1962), Denison (1962), Mushkin (1962), Mushkin and White (1992), and Schultz (1961). Other works such as Mekdad et al. (2014) indicated that investment in education and health helps to develop human capital by developing the skill capacity of labour as well as good health.

Education spending has both short-term and long-term effects on economic growth and development (Hanushek, 2013; Tamang, 2011). Lucas, (1988) argued that public spending on education increases human capital, which contributes to a knowledge-based economy and thus to economic growth. Zagler and Dürnecker (2003) also argued that fiscal policy tools such as public spending on education, health, and other key sectors have long-term effects on a country's economic growth. Although education is an important contributor to the development of the research sector, generating new insights and incentives that affect economic growth and make individuals more efficient and productive, also leads to improved creativity, new technological inventions, and innovations. Improved health leads to efficient and sustainable use of knowledge and skills that individuals acquire through education (Schultz, 1999).

Barro (1996) also suggests that better health can limit the devaluation of educational capital, thus increasing the positive effects of education on growth. The health sector has a major impact on the country's economic development. According to Bloom et al. (2004), a healthy person is more productive at work, offers more hours of work, invests more in training, and also saves the expectation of a longer life. A similar work by WHO (2019)

showed that a 10% increase in life expectancy at birth will increase the economic growth rate by 0.35%. It is also estimated that 50% of the growth gap between rich and poor is due to poor health and life expectancy. The above shows that public spending on education and health has a positive impact on human capital development, hence economic growth and development (Ogundari & Abdulai, 2014).

The importance of human capital has led to an increase in the allocation of resources in the education and health sectors among African countries. In April 2001, African Union countries met and committed to setting a target of at least 15% of their annual budget to improve the health sector and urged donor countries to step up support. As a result, public health expenditure in Africa is currently estimated at 1% of GDP and up to 16% of GDP. Sierra Leone spent between 15% and 16% of GDP from 2002 to 2011, while Ghana spent between 4% and 7% of GDP in the same period (WDI, 2014). The education subsector has also seen a significant increase in public spending in the recent past. African governments are deeply committed to education, which averages 16% of their budget. Ghana provided 23.1% of its resources in education between 2006 and 2009. In 2011 and 2012, this rose to 30% and 37.52%, respectively.

Although Africa spends an average of 6.1% of GDP on health, according to the WHO report in African Bulletin (2019), maternal and child mortality rates are high in the African region. Globally, 19 of the 20 countries with the highest maternal mortality rates are in Africa, while 50% of children under five who die from pneumonia, diarrhea, measles, HIV, tuberculosis, and malaria are of African descent (WHO, 2019). According to UNESCO, African countries spend an average of 5% of their GDP on education. In 2017, public spending on

education as a percentage of GDP was estimated at 4.23% for Africa, compared with 3.39% for Southeast Asia and 3.38% for Asia. It is noteworthy that nearly half of all African countries (46%) meet both of the United Nations-recommended goals for education funding of 4% or more of GDP and 15% or more of the government budget. However, Africa is noted for the highest educational exclusion rate, although it spends a large part of its gross domestic product on education. Over a fifth of children between the ages of 6 and 11 do not attend school, followed by a third of young people between the ages of 12 and 14. This shows that increased spending on health and education alone does not necessarily bring positive results, but the efficient and effective use of these resources.

To achieve the needed results, the efficient use of these resources has been a topic of debate in recent times. As a result, empirical assessment of public spending is concerned with the efficiency and effectiveness of public sector activities (Chan et al., 2017). The existence of market failures and the need for distribution policies require economic intervention by the government. Public spending is a powerful tool in government efforts to create better conditions for market efficiency. Because of the significant differences between social and private rates of return on investment in health and education, governments often spend on those sectors of the economy where private investment is insufficient. There is widespread recognition that efficiency in public spending is vital to sustaining long-term economic growth, reducing income inequality, and reducing poverty (Chan & Karim, 2012; Esanov & Kuralbayeva, 2011).

However, a growing body of literature documents the inability African countries to make government spending decisions and the inefficiency in

implementing public sector projects (Esanov, 2009; Esanov & Kuralbayeva, 2011). Gupta and Verhoeven (2001) demonstrated that African countries are inefficienct in fiscal policy implementation as compared to other regions. This is especially true in countries, where the lack of necessary capacity and weak institutions exacerbate the situation. In a country with poor institutions, a larger government or a sharp rise in public spending can distort the market and lead to corruption, instead of providing the public goods needed to increase the efficiency of the market (Esanov & Kuralbayeva, 2011). Efficiency of public spending is defined as the ability of a government to maximize its economic activities to the level of spending or the ability of the government to minimize its spending to the level of economic activity (Afonso & Fernandes, 2003; Gupta & Verhoeven, 2001). The government needs to spend the money raised from taxpayers efficiently in important sectors of the economy as it is accountable to its citizens. In this context, the concept of efficiency evaluates the allocation of resources into developing human capital.

Growing public spending also requires an increase in revenue. However, this has become a major challenge as African countries are unable to generate enough income internally. Other than tax revenue, all other sources of revenue are unreliable and therefore African countries mainly rely on limited tax revenue. Africa is also characterized by a large informal sector, so reliance on a small formal sector has made it difficult to generate enough tax revenue to meet the growing public spending. The average tax rate in Africa has been 17.2% since 2015, compared with the OECD average of 34.2% and the Latin American and Caribbean average (LAC) of 22.8%% (OECD, 2017). Most African countries are struggling to meet the United Nations recommended minimum

tax rate of 20% on GDP. Limited resources from tax revenues in Africa require recourse to other sources of finance to meet the rising expenditure, hence the increase in borrowing.

Public debt growth is a major concern in Africa as too many loans are taken out to finance the budget deficit. Nineteen African countries have exceeded the 60% debt-to-GDP threshold set in African Programme for Monetary Cooperation (AMCP) for developing countries, while twenty-four (24) African countries have exceeded the 55% debt ratio from the International Monetary Fund (IMF). According to the World Bank (2018), almost 40% of the countries in sub-Saharan Africa (SSA) are at risk of a major debt crisis. Eighteen (18) countries are at high risk of debt problems, double the 2003 risk, while eight (8) countries are already in trouble. Africa's external debt was estimated at an average of $ 39 billion in the 1970s and rose to just over $ 317 billion in the late 1990s. During the same period, total debt servicing paid by the continent rose from around $ 3.5 billion to a high of $ 26 billion. As of 2020, African countries such as Angola, Ethiopia, Zambia, the Republic of Congo, and Sudan have recorded the highest debt to the Chinese alone at US $ 25 billion, US $ 13.5 billion, US $ 7.4 billion, US $ 7.3 billion and US $ 6 respectively. According to the International Monetary Fund (IMF), African countries will need nearly 410 billion euros to repay all foreign debt by 2023.

Income inequality is another concern to policymakers due to its consequences on economic growth and development (Brueckner & Lederman, 2018; Hailemariam & Dzhumashev, 2020). Over the past two decades, evidence from around the world has shown that high levels of inequality adversely affect everything from economic growth to poverty to social cohesion and public

health (Boikova & Dahs, 2018; K. Chu et al., 2004; Lahouij, 2017; Liberytė & Navickas, 2020). A similar pattern can be seen in Africa, particularly about the impact of growth on poverty reduction. Africa stands out as an extreme income inequality region by international standards, with a top 10% national income share of 54% and a bottom 50% share below 10%. Africa has the highest gap between average incomes of the top 10% and incomes of the bottom 50%. Average incomes of the top 10% are about 30 times higher than those of the bottom 50%, well above the value found in other extreme inequality regions. The gap is around 20 times in other extreme inequality regions such as the Middle East, India, or Brazil.

Reducing inequality is not only useful but also necessary. High inequality "divides and erodes socially" (Meiring et al., 2018). The African economy has grown rapidly over the past decade. Seven of the top ten countries with the highest growth rates are in Africa. However, the growth is concentrated in certain economic sectors and certain geographic areas within countries. The benefits of this growth are not widespread and large segments of the population are left out. Poverty has not fallen sharply or as fast as expected and the economic inequalities remain high. Of course, there are significant differences between the countries in the region and their directions of inequality. The agenda to fight poverty and reduce inequality as targeted in SDG goals 1 and 10 aims to end poverty and reduce inequalities of all kinds by 2030. This has led governments, academics, and planned institutions to develop strategies to achieve these goals. Prominent amongst them is the use of government spending to reduce inequality (Boussichas et al., 2019; Fund, 2015). Policymakers must

allocate limited resources in key areas of the economy such as health and education to fuel growth, reduce inequality and improve public debt.

Problem Statement

Government spending on human capital (Health and Education) continues to increase over the years. However, the efficiency of such spending is not well known. Inadequate access to information about spending efficiency on human capital not only undermines a critical evaluation of the outcomes of such spending, but also raises concerns on the size of government. Although several papers on efficiency exist (Afonso & Kazemi, 2017; Dutu & Sicari, 2016; Herrera & Ouedraogo, 2018; Kosor et al., 2019), not enough attention is focused specifically on Africa (Gupta & Verhoeven, 2001). This makes it difficult to properly situate issues concerning efficiency of public spending in the African context. This study seeks to fill the gap by employing recent data (2006-2017) to determine efficiency of public spending on human capital in Africa to help appreciate issues concerning efficiency of public spending in Africa in recent times. Again, previous studies have only determined the average efficiencies due to lack of data (Afonso et al., 2010; Afonso & Fernandes, 2003; Afonso & Aubyn, 2011; Gupta & Verhoeven, 2001). This makes it difficult to appreciate the dynamics over time. The study fills this gap by determining the annual differences in the efficiency of public spending on human capital to appreciate the dynamics over time.

Currently, about 40 % of African countries are at risk of debt distress. Admittedly, this problem has dire consequences on the continent. Growing debt crowds out private investment and undermines national savings and income and the continent's ability to respond to external shocks. High debt may also lead to

high taxation with its attendants economic and social distortions. As underscored by the SDGs 1, addressing public debt has become a priority.

While some studies have suggested government spending cut as a prudent policy measure to reduce public debt given the challenges in Africa regarding revenue generation (Alesina & Passalacqua, 2016; O. J. Blanchard, 1990; Divino et al., 2020), others also think spending cut stifles economic growth and therefore suggest increase in public spending to reinvigorate economic growth which will reduce the debt to GDP ratio (Guajardo et al., 2014). While these studies allude to the role of government spending, they fail to examine efficiency of public spending and the extent to which it influences public debt.This study extends the literature by investigating how efficiency of public spending on human capital (Health and Education) influences public debt in Africa. It further identifies the minimum efficiency level of public spending required to improve public debt in Africa

Finally , income inequality has also attracted serious attention among policy makers and planned instituions in Africa. 10 out of the 19 most unequal countries globally are in Africa. This has a serious consequence on economic growth and development. High-income inequality divides and erodes socially, create security issues and stifle growth. This calls for an urgent need to bridge the income inequality gap in Africa. The effect of public spending on income inequality (Altunbaş & Thornton, 2020; Cevik & Correa-Caro, 2020; Chu et al., 2004; Siburian, 2020) and income redistribution (Doerrenberg & Peichl, 2014; Hoeller et al., 2013, 2014; Lustig et al., 2013) is well documented in previous studies. However, these studies have only concentrated on the effect of the type, size, and composition of public spending and their effect on income inequality

without paying attention to the efficiency of public spending and its effect on income inequality. This neglect of the issue of wastage in spending raises concerns about the efficiency of public spending as a redistributive policy tool particularly in Africa. This study fills the gap by investigating how efficiency of public spending on human capital influences income inequality in Africa. The study further identified the minimum level of efficiency of public spending needed to improve income inequality in Africa. This study concentrated on human capital (education and health) due to the critical role human capital plays in economic growth and development.

Purpose of the Study

The purpose of the study is to compute and examine the effect of the efficiency of public spending on human capital (education and health) on public debt and income inequality in Africa.

Objectives of the Study

The objectives of the study are to;

1. Compute and evaluate the relative technical efficiencies of public spending on human capital in Africa.
2. Examine the relationship between efficiency of public spending on human capital and public debt in Africa.
3. Examine the relationship between efficiency of public spending on human capital and income inequality in Africa.

Hypotheses of the Study

Given the above objectives, the study seeks to test the following hypothesis;

1. H_0: Efficiency of public spending on health has no effect on public debt.

2. H_0: Efficiency of public spending on education has no effect on public debt.
3. H_0: Efficiency of public spending on health does not reduce income inequality.
4. H_0: Efficiency of public spending on education does not reduce income inequality.

Significance of the Study

In the past few decades, most African countries have seen increases in public spending, particularly in the areas of health and education. Recent events on the continent suggest that the level of education and the quality of health are steadily increasing, although some member countries continue to suffer slowly in these two sectors. The study, therefore, tries to find out how best governments in Africa use the available resources to reduce the social well-being of their people, especially in the areas of quality health care and education to have a long-term effect on public debt and income inequality. In the past, some efficiency analysis studies have been conducted with mixed results on the efficiency of public spending. Similar research has been carried out in the past, for example on the efficiency of government spending in countries such as Latin America, the Caribbean, and other OECD countries.

Therefore, a gap in the literature on government spending efficiency needs to be filled using recent data and to situate the debate in the African context for a better appreciation. This study extends the existing literature by estimating technical efficiency over time. The results of this study will enable governments and policymakers to understand the level of resource efficiency in the two sectors (education and health) and the extent to which macroeconomic

factors influence the level of efficiency. It will help policymakers to formulate appropriate policies to enhance efficiency in spending which is expected to improve public debt and income inequality. This study is useful because it adopts a holistic approach and identifies the minimum efficiency of public spending levels on health and education that is needed to improve public debt and income inequality in Africa. Policymakers can gain a better sense of direction they need to enable them know how efficiency of public spending on human capital can reduce public debt and income inequality.

The study will also help identify important factors as well as their degree of influence on efficiency of public spending on human capital. This will help develop appropriate strategies aimed at ensuring efficiency of public spending to help reduce public debt and income inequality.

Delimitations of the Study

This parts highlights the boundaries used for the study and their justifications underlying the choices made. This study did a country level analysis by using available data from the World Bank's World Development Indicators (WDI) and World Governance Indicator (WGI) database from 2006 to 2017 for sixteen countries for empirical chapters one and two. While available data from WDI, WGI, and Standardized World Income Inequality Data (SWIID) from 2006 to 2017 for 16 countries were also used to achieve the third empirical chapter of this study. It is interesting to note that, there is not enough literature on how efficiency of public spending influences public debt and income inequality in Africa hence empirical evidence on the subject is sparse, especially the threshold of efficiency of public spending on human capital required to influence public debt and

income inequality. Therefore, the literature review is limited to available evidence which suffices for the build-up of arguments and analyses

This study specifically measures the relative efficiencies of public spending on education and health, examines the factors influencing public spending efficiencies on health and education in Africa. The effect of efficiency of public spending on public debt and income inequality in Africa was also examined.

Limitation of the Study

The study has provided the opportunity to investigate efficiency of public spending on human capital and how it affects public debt and income inequality in Africa. Despite its significant benefits to academic knowledge and policy, the methodological choices in terms of design, data, and estimation techniques are not entirely devoid of limitations that could not be addressed during the study.

The study was limited to only sixteen African countries due to data availability. The analysis did not include all African countries because these countries did not have data for the period under review. This made it difficult to conduct trend analysis on all African countries, hence the choice of sixteen African countries. Again, data on output educational variables such as PISA scores and youth literacy rate were not available for an analysis hence the reliance on gross primary school and gross secondary school enrollment as output variables for analysis. The study also used external debt as a proxy for public debt in this study. This makes it difficult to get a clear picture of how efficiency of public spending influence public debt. However, these limitations

do not undermine the results of this research but create an opportunity for further investigations.

Definition of Terms

This study used some key variables and terms. Below are the definitions of some of the variables and key terms used in the context of this study.

1. Public Spending is operationalized as government expenditure on health and education sectors
2. Efficiency of public spending is the ability of the government to maximize its economic activities to the level of spending or the ability of the government to minimize its spending to the level of economic activity.
3. Human capital focuses on health and education input which include people's knowledge and skills, acquired in part through education, but also include their strength and vitality, which depend on their health and nutrition to economic production
4. Public Debt is operationalized as the external debt stock to gross national income which is the sum of public, publicly guaranteed, and private non-guaranteed long-term debt, use of IMF credit, and short-term debt.
5. Income Inequality is the Gini coefficient which captures inequality in disposable income (post-tax and post-transfer).

Organisation of the Study

To achieve the objectives of the study, the study was organised into eight chapters. The next chapter, chapter two, presents the overview of public spending on human capital (health and education), public debt, and income inequality in Africa. The third chapter presents the theoretical and empirical

reviews. The review focused on the key relationship between efficiency of public spending, public debt, and income inequality. Chapter Four presents the methodological issues with a specific focus on Data Envelopment Analysis (DEA) and Systems Dynamic Panel Regression. Other techniques such as DEA bootstrapping method, Lind and Mehlum test, and margins plot were employed for analysis.

Chapter Five presents the results of the first empirical chapter which is efficiency of public spending on human capital (health and education) as well as the factors influencing efficiency of public spending on human capital in Africa. Chapter Six presents empirical results on the effects of efficiency of public spending on human capital and its effect on public debt. Chapter Seven shows empirical results on efficiency of public spending on human capital and its effect on income inequality while chapter eight presents the summary, conclusions, and recommendations of the study.

CHAPTER TWO

OVERVIEW OF PUBLIC SPENDING ON HUMAN CAPITAL AND OUTCOMES, PUBLIC DEBT AND INCOME INEQUALITY IN AFRICA

Introduction

This section presents the general overview of public spending on health and education and its outcomes, public debt, and income inequality for Africa within the period under study. The chapter also presents some descriptive statistics on the average spending levels within the period under study.

Public Spending on Health

Health Spending is fundamental to the ability of health systems to maintain and improve human welfare. Without financing, skilled and appropriate health workers would not be employed, medical equipment would not be available and health promotion or prevention of disease would not take place (WHO, 2009). Health Spending reflects the overall level of consumption of health goods and services by the population across countries (Onarheim et al., 2018). Investing in the health care system will not only lead to healthier lives, but it also create employment, enhance political and social stability, and contributes to economic growth and productivity (Onarheim et al., 2018).

In 2015, the world spent USD 7.3 trillion on health, which is close to 10% of the global gross domestic product (Tao et al., 2020). Health spending per share of GDP was greatest in high-income countries at nearly 12% on average (Tao et al., 2020). In low-income countries, health spending, on average accounts for 7% of GDP, and in middle-income countries 6% (Williams et al., 2020). Globally the health sector has consistently grown faster than economic

growth over the past 15 years (Williams et al., 2020). Between 2000 and 2015, the global health economy grew in real terms at an average annual rate of four (4) percent compared with 2.8 percent for the global economy (WHO, 2018). The health economy in low-income and lower-middle-income countries has grown even faster, at more than 6.0 percent on average (WHO, 2018). In 2015, the average share of external resources to health spending in the thirty-one (31) low-income countries was around 30 percent while in the fifty (50) lower-middle and fifty seven (57) upper-middle countries it was only three (3) percent and less than percent respectively (Tao et al., 2020).

The way health care is financed varies considerably across countries (Barroy et al., 2017). Middle-income and high-income countries tend to have a higher share of health spending that is funded from compulsory prepaid sources, such as government budgets and social health insurance contributions (Barroy et al., 2017; WHO, 2009). Public funding has increased slightly over the past 15 years from an average of 48 percent to 51percent of current health spending in middle-income countries and from 66 percent to 70 percent in high-income countries (Barroy et al., 2017). In low-income countries, domestic government sources have declined from 30 percent to 22 percent as aid increased from 20 percent to 30 percent (Williams et al., 2020).

According to the Abuja Declaration in 2001, African Union member heads of state agreed to allocate at least 15 percent of annual expenditure to health care (WHO, 2014). Fifteen years later in 2014, most African countries had increased the proportion of total public expenditure allocated to health care (Kiross et al., 2020). Although health expenditure in Africa is the lowest

compared with other regions, most African countries have improved their budget allocations to health over the past 15 years (WHO, 2014).

The source of health care financing in the African region was mostly from private sources and largely out-of-pocket expenditure; WHO estimates that up to 10 percent of the population in the region suffer a financial catastrophe each year due to out-of-pocket expenditure, with up to four (4) % pushed under the poverty line of the region (WHO, 2019). Government health expenditure in Africa does not always go up with increasing national income or government revenues. For instance, high-income countries in Africa did not systemically allocate higher priority to health care in their government spending (Gimigliano & Negrini, 2017). In contrast, a few lower-income countries such as Ethiopia, Gambia, and Malawi have allocated more than 15 percent of their public spending to the sector (WHO, 2014). The level of health expenditure in a nation is one important measure of the level of health investment; thus, it is recognized as an important input, just like exercising and dieting, in improving health outcomes (Grossman, 2000).

Average Public Health Spending in Africa

Figure 1 shows the averages of public health spending as a percentage of GDP among the countries under study.

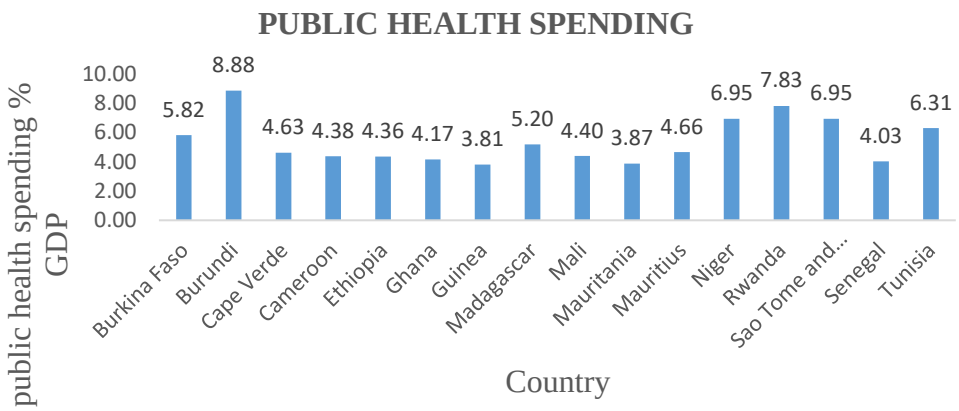

Figure 1: Public Spending on Health

Source: Sikayena (2022)

On average, Burundi has the highest of 8.8% followed by Rwanda 7.83%. Niger and Sao Tome and Principe were found to have an average public health spending of 6.95% while Tunisia recorded an average health spending of 6.31%. Guinea was found to have the lowest average of 3.81% as compared to its peers within the period under study. It is important to note that, the reason why Burundi and Rwanda recorded the highest public health spending as compared to their peers is because of the post-war reconstruction phenomenon of the health system. A lot of funds were allocated in the health sector to revamp the nearly collapsed health system during the civil war period. Ghana, Cape Verde, Cameroon. Ethiopia, Mali, and Senegal were found to have an average health expenditure below 5% of GDP. However, Burkina Faso and Madagascar recorded 5.82% and 5.20% respectively.

Health Outcomes in Africa

For the past decades, developing countries and for that matter, African countries have seen the life expectancy of their population reduced by communicable and parasitical diseases that have mostly been eliminated in the

developed countries. The continent is also experiencing increasing rates of non-communicable lifestyle diseases which have become killers in the developed nations. Many countries in the continent are still not able to provide necessities of life such as proper sanitation, potable and safe water, and an 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 health sector which is necessary for growth and development. The success and growth of every economy largely depend and the levels of literacy and health standards of the larger population. However, countries within the continent 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 continent 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 bad roads that make access to good health care a challenge.

Countries in Africa also continue to struggle with communicable diseases such as HIV/AIDS, TB, and Hepatitis B. According to the World Health Organization (2019), Africa bears 66 percent 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 continent. In 2000, United Nations

Millennium Declaration was agreed by 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), which is 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 immortality is regarded as a sensitive indicator of availability, utilization, 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 Africa 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 of 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-region have a life

expectancy below 60 years. These figures show the deplorable state of healthcare in Africa despite the huge investments in this sector.

Average Life Expectancy Rate in Africa

Figure 2 presents the average life expectancy at birth for Africa within the period under study.

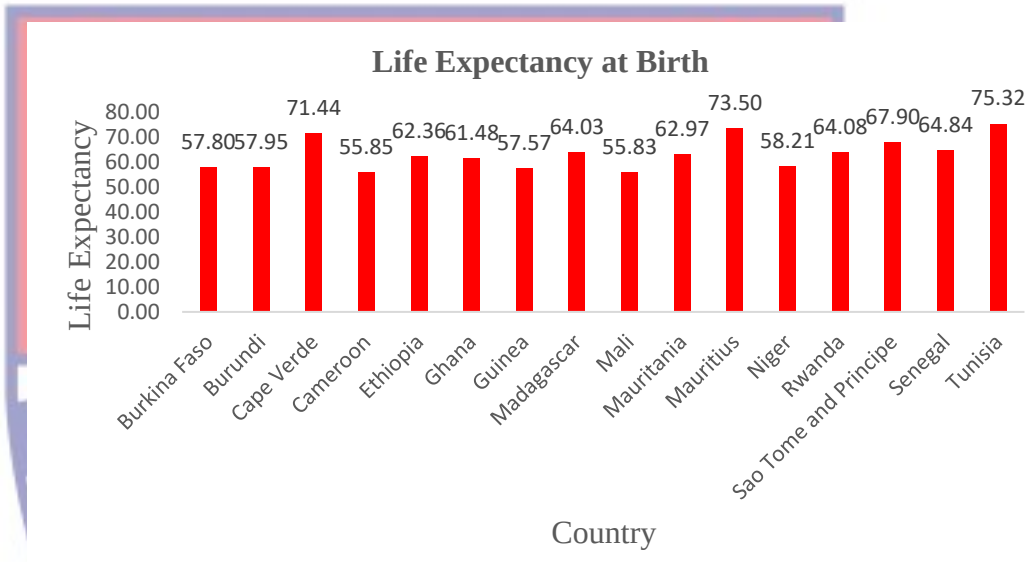

Figure 2: Life Expectancy at Birth

Source: Sikayena (2022)

It can be observed from figure 2 that Tunisia had the highest at 75.32 years. That is average, a person spends 75.32years before death in Tunisia. This is followed by Mauritius and Cape Verde having 73.5years and 71.44 years respectively. Mali recorded the lowest average of 55.83 years followed by Cameroon with an average of 55.85 years. Ghana, Ethiopia, Madagascar, Mauritania, Rwanda, Sao Tome Principe, and Senegal were found to record an average Life Expectancy beyond 60 years.

Average Maternal Mortality rate for Africa

Figure 3 shows the average mortality rate for Africa.

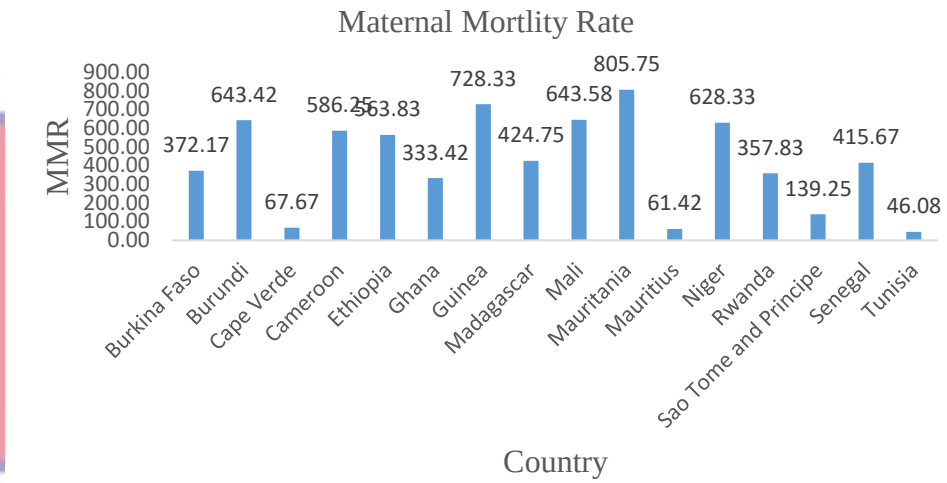

Figure 3: Maternal Mortality Rate

Source: Sikayena (2022)

Mauritania recorded the worst average of 805.75 per 100,000 live birth. This was followed Guinea and Mali with a Maternal Mortality rates (MMR) of 728.33 and 643.58 per 100,000 live birth respectively. Tunisia recorded 46.08 per 100,000 live birth followed by Mauritius and Cape Verde with an average MMR of 61.42 and 67.67 per 100,000 live birth respectively.

Average Infant Mortality Ratio in Africa

Figure 4 also presents the average infant mortality rate for the selected countries.

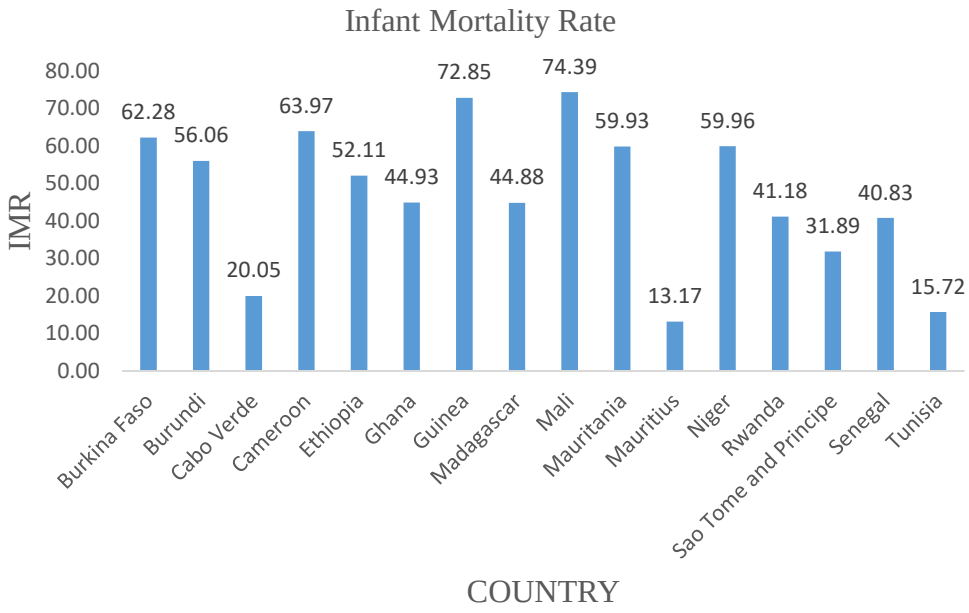

Figure 4: Infant Mortality Rate

Source: Sikayena (2022**)**

These averages were extrapolated from the world development indicator (WDI) database. The average Infant mortality rate (IMR) was found to be highest for Mali recording 74.39 per 1000 live birth followed by Guinea recording the second-highest of 72.85 per 1000 live birth. Mauritius, Tunisia, and Cape Verde recorded the lowest of 13.17, 15.72, and 20.05 per 1000 live birth respectively.

Public Spending on Education and Education outcomes

In the recent past, African countries have committed a significant amount of resources to education. The education expenditure is made up of current expenditure and capital expenditure of the educational institutions and the Ministry of Education. The share of public spending as a percentage of total public spending is an indicator of the state's commitment to educational development. African development bank report, African Economic Outlook, (2020) indicated that, on averagely, African governments spend about 5% of

GDP on education, which is the second-highest of any region. Ghana, for example, devoted 23.1% of its resources to education between 2006 and 2009, the second largest in the sub-region. In 2011, Ghana increased its share of total government spending to 30%. Average public spending on education as a percentage of GDP is presented in figure 5.

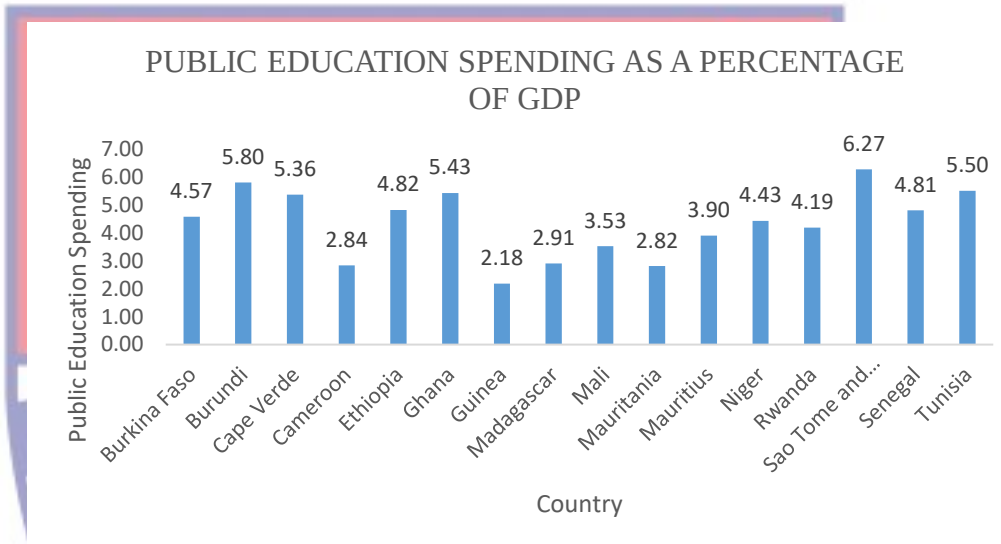

Figure 5: Public Education Spending

Source: Sikayena (2022).

These averages were calculated based on data collected from WDI from 2006 to 2017. Figure 6 shows that Sao Tome and Principe recorded the highest (6.27%) followed by Burundi (5.80%), Tunisia (5.50%), and Ghana (5.43%). Guinea was found to have the lowest (2.18%) followed by Cameroon (2.84%).

Gross Primary School Enrolment

Average gross primary school enrolment (% gross) is presented in figure 6.

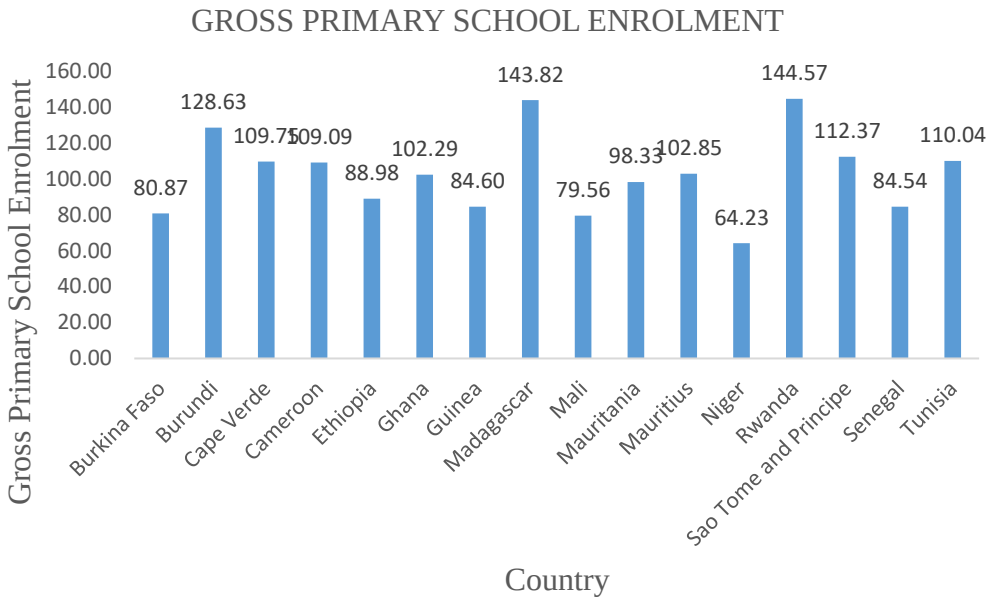

Figure 6: Gross Primary School Enrolment

Source: Sikayena (2022)

The gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. It indicates that Rwanda recorded the highest rate of 144.57. This was followed by Madagascar and Burundi with an average ratio of 143.82 and 128.63 respectively. Niger recorded the lowest ratio of 64.23.

Gross Secondary School Enrolment

Figure 7 presents the average gross secondary school enrolment (% gross) calculated from 2006 to 2017 from world development indicators WDI data.

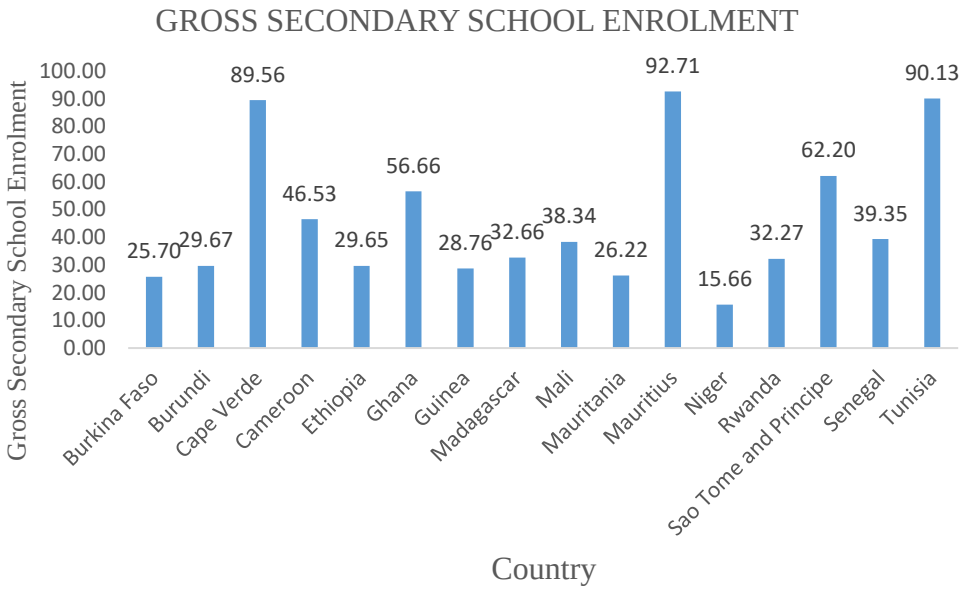

Figure 7: Gross Secondary School Enrolment

Source: Sikayena (2022)

It shows that Mauritius recorded the highest ratio of 92.71 followed by Tunisia and Cape Verde with an average rate of 90.13 and 89.56 respectively. Niger recorded the lowest 15.66 followed by Burkina Faso with an average of 25.70. From figure 7, it can be seen that, countries such as Rwanda and Madagascar who were topping the gross primary school is no where near the gross secondary school chart. This implies that, most of the student in these countries are not able to advance their education to the secondary school level after the completion of primary school. However, countris such as Mauritus, Cape Verde and Tunisia were consistent in both gross primary school and gross secondary school enrollements

Public Debt in Africa

The debt landscape of many African countries has changed significantly since the beginning of the global financial crisis from 2007 to 2008. Africa had

a record low-interest rates and the lowest African debt worldwide, the debt relief for the Heavily Indebted Poor Countries (HIPC) and the Multilateral Debt Relief Initiative (MDRI) led to improved access to new sources of finance, in particular to non-concessional loans. In some countries, debt has risen sharply in a short period which, if not contained , could lead to excessive debt problems such as have been observed in low- and middle-income countries over the past few decades. In addition, the changing global economic and financial conditions require careful monitoring of Africa's debt situation.

A study conducted by Battaile et al. (2015) on the debt sustainability in Sub-Sahara Africa (SSA) revealed that the public debt burden in SSA more than tripled between 1980 and 2000, before falling in 2006 to the level last seen in the early 1980s. The SSA's national debt burden grew rapidly in the early 1980s as the Latin American debt crisis spread to developing regions around the world, including Africa. Public debt as a percentage of GDP rose dramatically, from an average of 30% in 1980 to 83% in 1987. It continued to grow, albeit at a slower pace, peaking at 103% in 2000. The combination of improved economic growth and the introduction of the HIPC and MDRI debt relief programme s led to a significant decline in the debt burden indicators of the SSA countries between 2000 and 2006.

There are four groups of African countries by key characteristics: oil-exporting countries, Low and Middle-Income Countries (LMIC), Low-Income Countries (LIC), and fragile countries. The national debt to GDP ratio rose dramatically for all country groups until 1986 and more slowly until the early 1990s after the debt crisis had fully manifested itself. The strongest increase occurred in the oil-exporting countries due to the further decline in nominal

production parallel to the oil price. Debt began to decline in 1994, along with the fastest economic growth seen in all but vulnerable economies. The latter group did not see a sharp decline in public debt until the early 2000s when output growth accelerated and debt relief programme s began to take effect. The deleveraging also explains the sharp decline in LIC debt in the mid-2000s.

A country-specific look reveals full heterogeneity in the shift in debt burdens. In 2013, the SSA countries reported an average Public to Publicly Guaranteed (PPG) debt ratio of 42%. This is a decrease of twelve percentage points compared to 2007 at the beginning of the global financial crisis. A report by World Economic Output shows that there is a significant dispersion around the average, as around 40% of countries had a debt of over 40% of GDP at the end of 2013, there are still countries that have a public debt account for over 90% of GDP, namely Cape Verde, Mauritania, Sudan, and Eritrea (Del Rio Lopez & Gordo Mora, 2019). In addition, world economic performance (2014) shows that the 2013 average is heavily skewed by HIPCs that graduated after the crisis. In most of the sample countries, the government debt ratio rose slightly too moderately.

Domestic debt accounts for a large and growing proportion of total national debt for many countries. In 2013, domestic debt in 31 SSA countries with available data averaged about a third of the total public debt burden, or about 14% of GDP. Liabilities to domestic creditors currently account for 40% or more of the national debt of 11 countries, and many of these countries have achieved this exposure recently due to the much greater reliance on domestic creditors for funding after the global financial crisis (Del Rio Lopez & Gordo Mora, 2019). However, the projections reflected in the DSA analyses for all 31

countries suggest that a decline in domestic debt relative to national debt can be expected in the medium to long term.

External Debt Patterns in Africa

Most of the national debt in African countries comes from outside sources. The overall development of the external debt is similar to the development of the total public debt described in the previous subsection. Foreign debt stocks rose sharply due to the debt crisis of the 1980s, remained relatively stable for over a decade, and then began to decline sharply in the early 2000s, faster for LMIC and oil exporters and much slower for Fragile and LIC. However, debt burdens is similar across groups, which can be explained by debt relief (HIPC and MDRI), programme s that offset the low growth of fragile economies, and LICs.

Debt relief helps explain the sharp decline in external debt. The average debt relief from 1989 to 1998 was $ 3.8 billion, increasing to $ 5.2 billion in 1999 with the introduction of HIPC. Almost all debt relief 98% was targeted at LICs and fragile economies. Debt relief peaked in 2006 at $ 54.5 billion. The debt ratio of the LICs rose to 30% in 2006. This peak is led by Malawi, whose debt relief accounts for 80% of its GDP. Countries like Rwanda, Niger, Uganda, Tanzania, Mauritania, Mali, Ethiopia, Mozambique, Benin, and Burkina Faso have received debt relief of 22 to 39 percent of their respective GDP.

The share of facilitated financing from multilateral sources in total external debt rose steadily until around 2004 and remained high in LIC and fragile countries. As expected, LICs and fragile countries have the highest proportions of subsidized debt, although oil exporters now have subsidized debt that more than half of their foreign debt, higher than the corresponding share in

the LMICs. The share of multilateral debt in external debt has steadily increased for LICs and fragile economies until debt begins to decline, suggesting that post-debt multilateral debt began to replace private debt. The share of multilateral and subsidized debt increased until the early 2000s when production begins to rise, while debt servicing in Public and Publicly Guaranteed (PPG) as a share of GNI steadily declined.

The increased relief helped lower debt-to-liquidity ratios by lowering debt servicing in fragile countries and LICs. The 2008-09 sub-prime crisis resulted in a brief increase in interest payments and short-term debt in all groups except LICs. This is explained by the liquidity bottleneck associated with the crisis.

The peak of short-term debt was more evident in fragile and lower-middle-income countries, while in the latter case the peak was more persistent. Debt and debt service indicators have been rising again since 2010, but have reached significantly lower values than in previous decades, especially in the case of LMICs, whose debts began to rise even earlier in 2007. This coincides with the reduction in concessional debt, lower growth, and the rise in primary deficits.

Similar to total public debt, the patterns described above indicate considerable heterogeneity between countries. For example, while the Group's external debt has been less subsidized overall since 2007 (the share of subsidies has decreased by 7 percentage points), the decline is double-digit for some countries, while an increase has been recorded for others for almost 20 percentage points. The changing financial conditions after the global financial

crisis have allowed African countries to slightly reduce their short-term debt dependency and funding costs, the results differ widely between countries.

Despite record-low interest rates and generally favorable global financial conditions in recent years, the heterogeneity of African countries in terms of debt behavior and fiscal reactions to the global financial crisis has in some cases deteriorated significantly (Battaile et al., 2015). According to Battaile et al.(2015), all Sub-Sahara African (SSA) episodes in which the Current Account Balances (CAB) changes by more than ten percentage points of GDP over five years. Between 2003 and 2008, countries tended to improve their CABs although in some cases this was achieved with unsustainable reductions in investment. Since then, countries have tended to see their CAB deteriorating, and only in two cases (Mauritania and Mozambique) has this been due to a significant increase in investment. In Namibia, Cape Verde, Botswana, the deterioration in CAB was caused by a significant increase in consumption or decrease in savings.

Average Debt as a ~~percentage~~ Percentage of GDP in Africa

Figure 8 presents the average debt to GDP ratio from 2006 to 2017 for Africa under study.

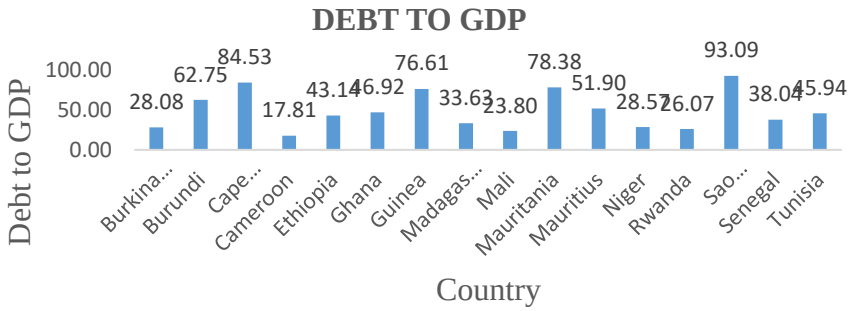

Figure 8: Average debt to GDP Ration from 2006 to 2017

Source: Sikayena (2022)

The results show that Sao Tome and Principe recorded the highest followed by Cape Verde. Cameroon recorded the lowest among its peers followed by Mali then Rwanda. It is obvious from figure 9 that on average, most African countries have exceeded the 55% debt to GDP threshold by IMF.

Average Income Inequality in Africa

Figure 9 presents the average income inequality from 2006 to 2017 for Africa.

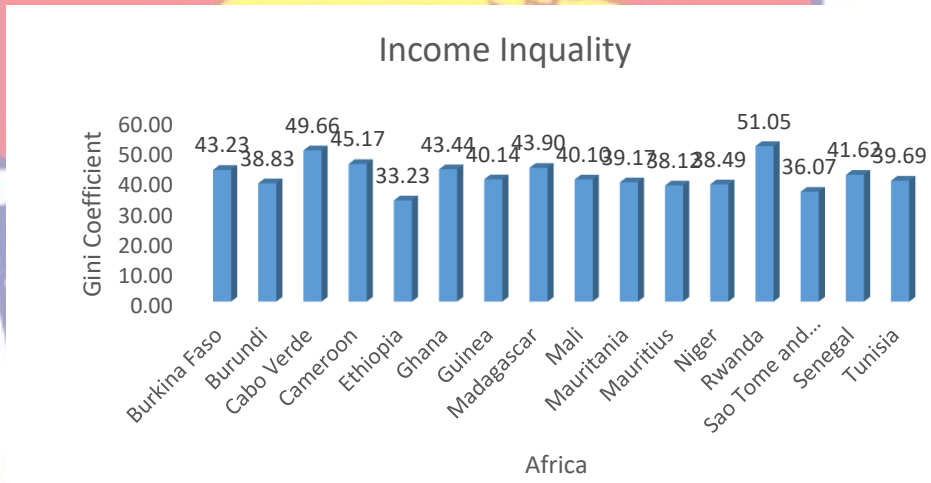

Figure 9: Average Income Inequality in Africa

Source: Sikayena (2022)

Rwanda recorded the highest average income inequality rate of 51.05% followed by Cape Verde with an average of 49.66%. This confirms the finding of SID 2013 which identifies Rwanda to have the highest level of inequality in East Africa. In 2011 it was reported that the richest 10% of Rwandans earned 3.2 times the income of the poorest 40% (SID 2013: 83)

A study conducted by Bundervoet et al. (2020) using the world bank data 2015 noted that Rwanda's high inequality is driven, in part, by location. It is substantially higher in urban areas (Gini of 58) than in rural areas (Gini of

40). According to Bundervoet et al (2020), 'differences in consumption between households in urban and in rural areas explains almost a quarter of total inequality. Figure 9 also identifies Ethiopia to have the lowest average income inequality of 33.23% as compared to its peers.

CHAPTER THREE

LITERATURE REVIEW

Introduction

To understand the dynamics in the literature, the study conducted both a theoretical and an empirical review of the literature that relates to efficiency of public spending, public debt, and income inequality. This puts the current study into its correct perspective. This chapter is composed of two main parts. The first part concentrates on the theoretical presentation of literature, while the second part concentrates on the empirical presentation of literature.

Theoretical Literature

This section discussed theories on human capital, public spending, efficiency, public debt, and income inequality. The section primarily provides an overview of human capital theories and public spending theories. The study also focused on the importance and nature of economic efficiency, as well as various methods of measuring efficiency. Public debt theories that covered different perspectives on economic schools of taught were also reviewed. Theories on inequality also followed.

Theoretical Review on Human Capital

Human capital dates back to the creation of classical economics in 1776, following which a scientific theory was formed (Fitzsimons, 1999). Schultz (1961) acknowledged human capital as one of the most essential variables for national economic growth in the contemporary economy, after the formalization of this idea as a theory. With the introduction and growth of human capital as an academic discipline, several academics have endeavored to elucidate how human capital might contribute to socio-political progress and liberty (Grubb & Lazerson, 2005).

The idea of human capital may be classified according to each academic discipline's standpoint. The first perspective focuses on the individual characteristics. Schultz (1961) saw human capital as "something like to property" in contrast to the idea of labor force in the classical perspective, and theorized that "the productive power of humans is today far greater than all other types of wealth combined." The majority of scholars have embraced his idea that the human potential consists of innate knowledge and abilities (Beach, 2009).Similar to his theory, a number of researches demonstrate that human capital is directly associated with knowledge, skills, education, and talents (Youndt et al., 2004). Rastogi (2002) defines human capital as an individual's innate knowledge, skill, attitude, and conduct.

There is a second perspective on human capital and its accumulation process. This viewpoint emphasizes the information and abilities acquired via educational activities such as compulsory schooling, higher education, and vocational education (Fuente, 2011). Despite the expansion of this notion, this viewpoint disregards the fact that humans gain information and abilities via their own experience. Human capital is seen from a production-oriented perspective.

Human capital is a primary source of economic productivity (Romer, 1990). Human capital, according to Hout and Rosen (1999) is "an investment that people make in themselves to boost their output." Kwon (2009) describe human capital as "a collection of qualities such as education, experience, training, intellect, energy, work habits, trustworthiness, and initiative that influence the value of a worker's marginal output." Human capital, from a production-oriented standpoint, is "the store of skills and knowledge represented in the capacity to do labor in order to generate economic value"

(Harpan & Draghici, 2014).In addition, from a social viewpoint, some scholars describe human capital as "the information, skills, abilities, and traits of persons that promote the production of personal, social, and economic well-being" (Rodriguez & Loomis, 2007).

Consequently, human capital encompasses both the instrumental idea of generating certain values and the 'endogenous' concept of self-generation. Without a doubt, learning via education and training may play a crucial role in establishing the notion of human capital in order to produce these values either independently or dependently. In light of the fact that experience may be considered a type of knowledge, human capital is synonymous with the knowledge innate to individuals.

Lucas Human Capital Growth Model

Human capital is the capabilities, skills, and knowledge that an individual worker possesses. Human capital is both rival and excludable (Romer, 1989). Lucas introduced human capital in the growth model by assuming a production function with two forms of capital which are physical and human capital as presented below

$$NY = AK^{\alpha}H^{1-\alpha} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where NY denotes national income,K denotes physical capital and H indicates human capital. The model assumes diminishing marginal returns of both physical and human capital (David, 1996). Lucas model of human capital also assumes a direct relationship between human capital and economic growth. This means economic growth is achieved through the accumulation of human capital.

Public Spending Theories

This section discussed theories on public spending. Specifically, the Keynesian theory on public spending, Wagner's hypothesis, and Peacock-Wiseman hypothesis were discussed. It also expressed the various modifications of Wagner's hypothesis in functional form by other researchers.

The Keynesian View on Public Spending

The theory was named after the economist John Maynard Keynes (1883-1946). As opposed to the classical economist's view of a free-market economy, Keynes highlighted the importance of the government sector in regulating the economy soon after the Great Depression of the 1930's. Keynes proposed savings-investment and aggregate demand-aggregate supply methods to determine national income. The two methods result in the same level of national income. This study aligns with the aggregate demand-aggregate supply method. The study seeks to examine how influential loose or tight fiscal policy is towards aggregate demand and the economy as a whole. The keynesian model assumes the existence of the government sector which taxes people's incomes, spends on factor services, purchases goods, and services from the business sector.

Keynes argues the principal variable which governs the overall economic operation is the aggregate demand as presented below

$$AG_t = NY_t = C_t + I_t + PS_t + NX_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Equation 2 expresses the Keynesian macroeconomic model of national income determination. From the model, AG denotes aggregate demand, NY denotes national income, C denotes total consumption spending, I denotes total investment, PS denotes total public spending, NX denotes net exports, and t denotes period, if equation (2) holds, it follows that with the existing

unemployment rate and unused production resources, policymakers can improve employment and aggregate income through increasing spending for either consumption (C) or investment(I). Unless the government can intervene and manage the economy the entire system remains trapped and maintains equilibrium with low employment. Keynes argued that the government is required to encourage aggregate demand when an economy experiences high rates of unemployment.

Aggregate demand is encouraged among other things through increased spending on public goods. From equation 2, if C is total consumption spending, then

$C_t = c_0 + c_1 Y_t^d$ ……..(3)

This is consumption function whereas C represents consumption spending, c_0 represents autonomous consumption, while c_1 represents marginal propensity to consume (MPC) i.e., $\frac{dC_t}{dY_t}$ which is greater than zero but less than one. Additionally, Y^d represents disposable income and t stands for period. Note that

$Y_t^d = NY_t - T_t$ ……..(4)

By substituting equation (3) and equation (4) into equation (2) the study obtains the following equation;

$Y_t = C_0 + C_1(NY_t - T_t) + I_t + PS_t + NX_t$ ……..(5)

Taking derivatives throughout the equation (5) becomes

$dY_t = dC_0 + C_1 dY_t - C_1 dT_t + dI_t + dPS_t + dNX_t$ ……..(6)

Re-arranging equation (6) above we get

$dY_t = \frac{1}{1-C_1}(dC_0 - C_1 dT_t + dI_t + dPS_t + dNX_t)$ ……..(7)

Assuming that all other variables are constant except the component of public spending, this research measures how public spending relates to total national income and its impact on economic growth. This is given in equation (8) below;

$$dNY_t = \left(\frac{1}{1-c_1}\right) dPS_t \quad \text{.....(8)}$$

Equation (8) denotes the public spending multiplier. It can be noticed that the public spending multiplier is greater than zero implying that public spending and national income are directly related. This multiplier defines the rate at which national income increases when fiscal policymakers decide to increase public spending by one unit. Tang (2009) supports the idea of Keynes and postulates that an increase in public spending simultaneously causes higher income though it depends on the domination of the multiplier or the crowding-out effect of the private investment. The principal message about the income multiplier and crowding-out effect is that if the increase in national income is greater to the extent that it surpasses the negative effect which results from crowding out, then the economy grows; and vice versa is true. Therefore, if national income and public spending are directly related then developing economies can opt to increase public spending to stimulate aggregate demand. The increase in aggregate demand as demonstrated by the Keynesian hypothesis brings about economic growth.

Wagner's Hypothesis

Since the advent of Wagner's law in 1890, economists throughout the world have debated the causal link between economic growth and government spending. Wagner's law states that throughout the time of the industrial revolution, the proportion of public expenditures to total expenditures rises as the nation's real per capita income rises. Thus, "economic advancement or

development is responsible for the relative growth of the public sector" (Wagner & Weber, 1977). According to Paparas et al. (2019), the key tenet of this theory is that "economic development causes government expenditure."In contrast to the Keynesian hypothesis, which posits that national income is a function of public spending, Wagner's law assumes the opposite. The law assumes that the size of the public sector is a function of national income. Wagner's law also regards public goods as normal goods and their demand increases with increasing income. However, this hypothesis has been modified by different researchers at different times. Table 1 shows various modifications of Wagner's hypothesis.

Table 1: Different Modifications of Wagner's Hypothesis on Public Spending

Public spending (PS) as a function of national income	Author and period
$InPS_t = \theta_0 + \theta_1 InNY_t$	Peacock-Wiseman (1961)
$In\left(\frac{PS_t}{Pop_t}\right) = \theta_0 + \theta_1 In\left(\frac{NY_t}{Pop_t}\right)$	Gupta (1967)
$InFCS_t = \theta_0 + \theta_1 InNY_t$	Pryor (1968)
$InPS_t = \theta_0 + \theta_1 In\left(\frac{NY_t}{Pop_t}\right)$	Goffman (1968)
$In\left(\frac{PS_t}{NY_t}\right) = \theta_0 + \theta_1 In\left(\frac{NY_t}{Pop_t}\right)$	Musgrave (1969)
$In\left(\frac{PS_t}{NY_t}\right) = \theta_0 + \theta_1 InNY_t$	Mann (1980)
$In\left(\frac{PS_t}{NY_t}\right) = \theta_0 + \theta_1 In\left(\frac{NY_t}{Pop_t}\right) + \theta_2 In\left(\frac{BD_t}{NY_t}\right)$	Murthy (1994)

Source: Magazzino (2010)

The variables are defined as follows; PS is public spending, NY is national Income, FCS is final consumption spending, Pop is population, BD is budget deficit and t is period. θs are the coefficients.

In general, Wagner's law assumes that an increase in income increases consumption and that investments also increase. If one takes government expenditure as an endogenous factor that is determined by national income, then changes in the expenditure component influence aggregate demand, and the curve shifts to the right. A shift in the macroeconomic demand curve to the right means a short-term increase in real income. Over time, the aggregate supply curve shifts to the left to restore equilibrium, and, as a result, prices continue to rise. Eventually, the national income returns to the initial level ineffectively (Tang, 2009). This aggregate demand and supply model used by Wagner's law is the same that was used to demonstrate the Keynesian hypothesis.

Peacock and Wiseman Hypothesis

The study of the increase of public spending was advanced in the Peacock-Wiseman hypothesis in Great Britain from 1890 to 1955. The hypothesis focused on the public spending model, saying that public spending does not follow a good or continuous trend, but the increase in public spending is jerky or gradual. They gave three-wave concepts to justify the hypothesis, which is; Displacement effect, inspection effect, and concentration effect. According to the Peacock-Wiseman hypothesis, social or other disruptions in an economy make it necessary to increase spending because existing government revenues cannot remedy the disruption. The government's fiscal activities gradually rise to higher levels over the decades to cope with successive social upheavals.

Displacement Effect

When social disruption occurs, the government increases taxes to increase revenue and increases public spending to deal with social disruption.

This creates a displacement effect in which low taxes and expenses are replaced by higher taxes and expenses. However, once the riots are over, the new tax tolerance prompts people to support higher levels of public spending as they can bear a higher tax burden than before. As a result, the new level of government spending and revenue will stabilize, but will soon be destabilized by another new disruption causing another disruptive effect.

Inspection Effect

Even if there are no further disruptions, there is no strong motivation to go back to a lower level of taxes, as the increased revenue can be used to support higher levels of spending. As a result, the government is expanding its fiscal operations, partly to cause disruption, to expand economic activity, and take on new functions previously neglected. This is known as the inspection effect.

Concentration Effect

When an economy experiences economic growth, the economic activities of the central government tend to grow faster than the activities of states and local governments. This is known as the concentration effect. It is related to the political organization of the country.

In summary, it can be said that Peacock Wiseman's hypothesis about the development of public spending is more convincing than Wagner's. The natural progress and structural changes of an economy lead to a steady and systematic expansion of public spending. An increase in public spending is also due to urbanization, population growth, awareness of civil rights, and awareness of the duties of the central government.

Efficiency Theory

One of the issues which have become vital when addressing the issues of public spending is the question of efficiency. Hauner and Kyobe (2010) demonstrate that the efficiency of government to allot its resources, especially revenue resources is one of the key issues to be taken into account in our economies. If Sustainable Development Goals (SDG) and other economic objectives are expected to be achieved, then a higher degree of efficiency is essential in the allocation of public spending.

The theory of efficiency was introduced by an Italian economist and engineer Pareto (1909) and later on developed by Bergson (1983). The purpose of establishing efficiency theory was to demonstrate the optimal allocation of resources. The theorists assert that allocation is said to be Pareto efficient or Pareto optimal if it is not possible to increase output by reallocating resources. This is also Pareto equilibrium Levin, (2006)

Meaning of Efficiency

Over the years economists have raised both theoretical and empirical concerns about the concept of efficiency in questions of productivity and production analysis. Afonso and Kazemi (2017) describe the importance of the efficiency of public spending and posit that the state can invest its public funds to produce public goods and services that also improve the well-being of the majority of the economy as promoting economic growth. Furthermore, Albassam (2021) defines efficiency as the ability to use a minimum of resources (or inputs) to produce a certain level of output. Assuming that all governments are on their way to optimal growth of their economies, they will ultimately devote their resources to a meaningful approach that is expected to have a

positive impact on economic growth. It is said that public spending is efficient when public sector productivity stimulates growth and also improves well-being.

Types of Efficiency

This section discussed the types of efficiency in resource allocations. Specifically, the section discussed economic, allocative, and technical efficiency.

Economic Efficiency

Economic efficiency refers to the ability of the government to get maximum performance with a given set of inputs at a minimal cost. It encompasses the efficient and effective allocation and distribution of scarce resources to the greatest possible level and the elimination or reduction of waste. This is the case when every scarce resource in the economy is used and distributed among producers and consumers in such a way that most economic benefits are achieved for consumers. Economic efficiency can include efficient spending decisions by government, efficient production decisions in firms and industries, efficient consumption decisions by individual consumers, and efficient distribution of consumer and production goods to individual consumers and firms. Given the same resources, and economic system is seen as more efficient than its counterpart if it can achieve more results than others with a given input. Economic efficiency, therefore, means that one business agent cannot be improved without worsening another, which means that no additional product unit can be manufactured without an additional input unit. It also includes production at a minimal cost.

Economic efficiency has two main dimensions. Allocative and Technical efficiency. Jackman et al. (2017) explained economic efficiency as the ability to combine technical and allocative efficiency to reflect the ability of the government to produce at a minimal cost. Achieving economic efficiency is essential for every production process. Then for government to achieve economic efficiency, it must have technical and allocative efficiency. This, therefore, implies that government may have the best amount of product in exchange for using the cheapest price, the minimum amount of input, but that these characteristics may not be sufficient for productive or economic efficiency.

Allocative Efficiency in Public Spending

All financial plans ration resources by allocating money for some uses and withholding it from other areas depending on the desired direction of the government in power. The efficacy of public programme s depends on these allocations, but governments face numerous challenges to making accurate competent allocations in the economy. The main task of modern public spending management is to create conditions that promote allocative efficiency. Farrell (1957) explained allocative or price efficiency as the maximum "optimal" proportions of inputs to relative prices. Aparicio et al. (2017) also define allocative efficiency as the ability of the government to efficiently use costs that minimize the input ratio or revenue ratio that maximises revenue. Therefore Allocative efficiency is the ability of the government to allocate resources based on the effectiveness of public programme s in meeting its strategic target.

This involves the power to transfer resources from previous priorities to new ones, and from less to more useful programme s in the economy. Allocative efficiency demands that the government establishes and prioritises targets and that it assess the real contribution of government spending to those set targets. To allocate efficiently, the government must be tactical and evaluative, it must both look ahead and identify what it wants to realise and look back to scrutinise the outcome. The relationship of deliberate planning and programme appraisal to ongoing budget techniques has been a regular issue in government spending management. Establishing a tight link has been a frequent theme in budget reform during the past half-century in developing economies yet many governments have tried, yet only a few have succeeded. The rate of failure had been soaring for the reason that striving for allocative efficiency increases informational burdens, transaction costs, and political conflict in an economy.

Informational needs are higher because of the demand for additional facts on programme impacts, political conflict escalates because of efforts to redistribute budgetary resources. Modern public spending management must improve allocative efficiency without overstraining the ability of the government to process information and deal with conflict. Except for information demands and budgetary conflict are manageable, governments may favour sub-optimal allocations that permit them to muddle through the yearly financial plan exercises which have become an annual ritual in developing economies.

Technical Efficiency in Public Spending

Farrell (1957) defined technical efficiency as the ability of a production unit (government) to achieve maximum output from a certain input or to

generate a series of defined output with minimal inputs. It is the ability to make the most of a given set of production resources. Technical efficiency occurs when the government can produce output on a production possibility curve (PPC) (Koopmans, 1951). Koopmans's (1951) definitions of technical efficiency have often been found to be ineffective because other related output must be reduced to increase output. Ogundari (2013) also defines technical efficiency as the maximum possible level of output that can be achieved with a given set of inputs from a range of available alternative technologies. Public spending is technically efficient when an increase in output requires an increase in the other input or a decrease in the other output. This means that a technically inefficient government uses less than at least one input to generate the same output or to generate more than at least one output with the same inputs.

Lovell (1993) also correlates efficiency with comparisons between optimal values or "efficient output" and observed output with defined inputs. Lovell (1993) explains, however, that the resulting comparison measures the technical efficiency of the public spending if the study aims to determine production potential using optimal values. The basic idea of microeconomics relates to the decision-making of the government with the behavioral assumptions that determine production that is maximizing output and minimizing costs. This assumption, therefore, assumes that the government making production decisions always prefer to operate on efficient boundaries where maximum production is achieved. However, this goal of efficient production is often not achieved because production is inefficient. Therefore, the presence of technical inefficiencies in public spending has been at the fore in the current economic discussions.

The Importance of Public Spending Efficiency

When analysing whether the correlation between the level of public spending and public debt and income inequality, the efficiency of this spending must also be taken into account (Aghazadeh-Bektash & Dizaji, 2017; Angelopoulos et al., 2008). In addition, Florina (2017) shows the remarkable potential for increasing the efficiency of public spending. These efficiencies can be achieved either by increasing expected results after spending a certain amount of public funds or by reducing the funds required to achieve a given level of production. Even in a situation of minimal government intervention, the assumption that there is no effective market governance system cannot promise better economic outcomes (Hodgson, 2017).

Efficiency is central to explaining the relationship between the optimal level of public spending and public debt, income inequality, and economic growth. Above a certain threshold, increased public spending slows economic growth (Facchini & Melki, 2013; Lupu & Asandului, 2017; Tabaghua, 2017; Thanh et al., 2020). Therefore, economic growth depends on both public spending and the level of efficiency. Both public spending and efficiency must be considered to maximise growth. Kimaro et al. (2017) further postulate that the connection between efficiency and economic growth does not require a monocausal implication, that is, there is a simultaneity relationship between efficiency and economic growth. Hence the efficiency of the state determines economic growth. At the same time, economic growth determines the effectiveness of the state. For maximum efficiency, more public spending should lead to more results in the economy.

Policymakers need to recognise the difference between allocating resources to bad projects and using resources effectively, and allocate resources to the right projects, but inefficient. All of these difficulties are widespread and significant in our economies, and both lead to inefficient allocation of public funds (Afonso & Kazemi, 2017). In addition to efficiently allocating public funds to a bad project, shifts within the budget category remain problematic and distort the efficiency of spending. For example, funding for rural development can be diverted into funding for urban development, local public spending can be diverted to federal public spending, among others. These shifts are important in determining effectiveness, even if they do not change the total amount of the state budget (Afonso et al., 2020).

Measurement of Efficiency

In microeconomic theory, a production function is defined as the maximum output that can be generated from a given set of inputs when the technology available to the firms involved is available (Battese & Coelli, 1995). The maximum possible output becomes relevant to answer certain economic questions, for example, measuring the efficiency of the firm, and hence the introduction of frontier analysis that estimates maximum output as a function of inputs. Similarly, the cost frontier function would give minimum cost as a function of an output quantity and input prices.

The works of Debreu (1951) and Koopmans (1951) mark the origin of the discussion about measuring productivity and efficiency in economic literature. The work of Debreu and Koopmans was first extended by Farrell (1957) to measure productivity and efficiency. An economic agent's productivity can be measured simply as a scalar ratio of the outputs and inputs

that the agent uses in its production process. Productivity can be measured either as partial productivity such as output per hectare (land productivity) or production per person (labor productivity) or, more precisely, as Total Factor Productivity (TFP), which is defined as the ratio of total output to total input.

An economic agent's productivity can vary due to differences in production technology, the efficiency of the production process, the environment in which production takes place, and ultimately the quality of the inputs used by the agent (Nemati et al., 2015). On the other hand, efficiency is measured by comparing the observed and optimal levels of output and inputs. Before Farrell (1957), efforts were made to measure efficiency by interpreting the average productivity of the input data and then building an efficiency index.

However, economists rated these methods unsatisfactory as the methods suffered from one deficiency to another. The use of traditional least-squares methods to estimate the production function has been criticised for being inconsistent with the definition of the production function. The estimated functions could at best be described as mean or response functions since such a regression estimates the mean output rather than the maximum output of given input sets (Schmidt, 2011). This has led to the development of a well-grounded theoretical method of measuring efficiency, which is a frontier method. Frontiers models have been described as optimum functions (Battese & Coelli, 1995).

The Frontier Approach (FA) offers several advantages over the average or response functions as well as over non- frontier models. Two main advantages result from estimating frontier functions compared to estimating average functions using the ordinary Least Squares Approach (OLSA). First,

when assessing the FA, the outcome is greatly influenced by the best performing firm, and therefore the frontier reflects the set of technology used by the most efficient firm. The average function estimation, however, only reflects the technologies used by the average firm.

Second, FA provides a useful measure of performance. The FA typically represents best practice technologies that can be used to measure the efficiency of other firms in the industry. Frontier models (FM) also offer several advantages over non- frontier models (NFM) such as those proposed by (Silva et al., 2017). The NFM provides efficiency measures for groups of firms, while the FM can provide specific efficiency measures for the researcher. Another advantage of the frontier methodology is that the word "frontier" corresponds to the theoretical definition of the function of production, cost, and profit, that is, solutions to the maximum and minimum problem.

These advantages make the FM popular in applied economic research (Nemati et al., 2015). Frontier functions (FF) can be classified based on certain criteria. First, based on the way the frontier is specified, the frontier can be determined as a parametric input function or non-parametric. Second, it may or may not be cited as an explicit statistical model of the relationship between observed output and the frontier value. Finally, the FF can be classified according to how the deviation of a group of agents or firms from the agents with the best performance in the sample is interpreted

Non-Parametric Approach

The non-parametric approach (NPA) neither specifies the functional form of the production technology nor does it start from the distribution of the error terms. In other words, it is robust in terms of a particular functional form

and distributional assumptions. The NPA is mostly deterministic. In the deterministic model, it is assumed that the output is bounded above the deterministic (non-stochastic) limit (frontier). However, the possible influence of measurement errors and other statistical disturbances on the shape and position of the estimated limit is not taken into account.

Farrell (1957) serves as an important starting point for discussing nonparametric frontiers (NPF). It illustrated measuring efficiency using an input-oriented approach. His argument is shown in Figure 3.1. This representation takes into account a firm that uses two inputs X_1 and X_2 to produce output y, such that the production frontier is $y = f(x_1, x_2)$

Assuming constant returns to scale, then one can write $1 = f(\frac{x_1}{y}, \frac{x_2}{y})$, that is the frontier technology can be characterized by a unit isoquant and this is denoted SS' in figure 1. Knowledge of the unit isoquant of a fully efficient firm permits the measurement of technical efficiency. For a given firm using $y = f(x_1^*, x_2^*)$ defined by point A $[(\frac{x_1^*}{y}, \frac{x_2^*}{y})]$ to produce a unit of output y*, the ratio $\frac{OQ}{OP}$ measures technical efficiency and it defines the ability of a firm to maximize output from a given set of inputs. The ratio measures the proportion of (x_1, x_1) needed to produce y'. Technical efficiency takes a value between zero (0) and one (1) and therefore indicates technical inefficiency. Thus, the technical inefficiency of the firm, $1 - \frac{OQ}{OP}$, Measures the proportion by which (x_1^*, x_2^*) could be reduced (holding the input ratio $\frac{x_1}{x_2}$ constant) without reducing output. A firm that is fully technically efficient would lie on the efficient isoquant (example, point Q) and it takes a value of 1.

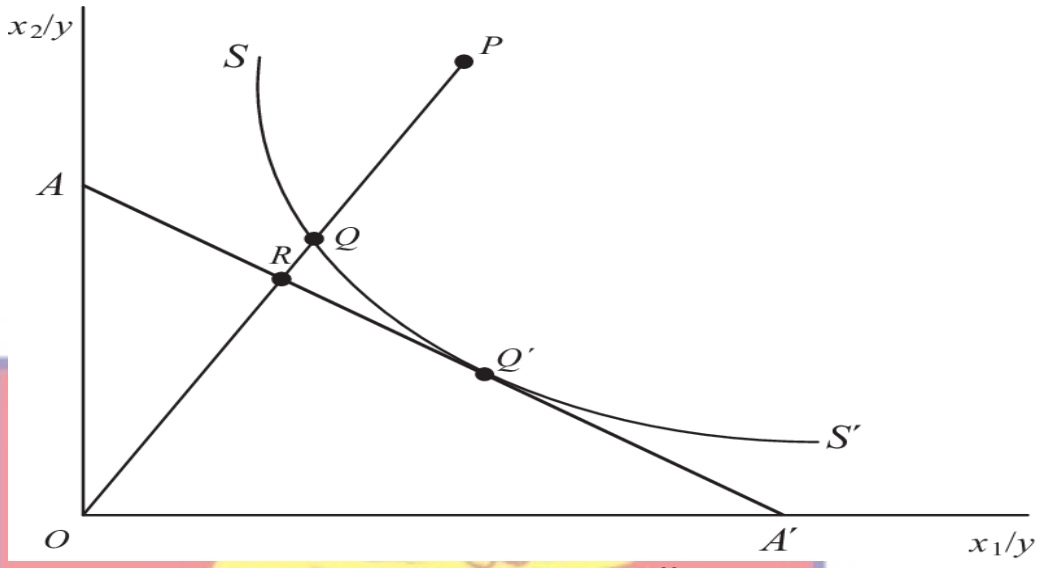

Figure 10: Technical, Allocative, and Economic Efficiency

Source: Sikayena (2022)

Further, Farrell demonstrated that the unit isoquant can provide a set of standards for measuring allocative efficiency. Let AA' represent the ratio of input prices. Then the ratio $\frac{OR}{OQ}$ measures the allocative efficiency (the ability of a firm to use inputs in optimal proportions, given the respective prices at point P). Correspondingly, allocative inefficiency is $1-\frac{OR}{OQ}$. The distance RQ is the reduction in production costs that would have been achieved had production occurred at Q' the allocative and technically efficient point, rather than Q the technically efficient, but allocative inefficient point. Finally, the ratio $\frac{OR}{OP}$ measures the economic efficiency and correspondingly $1-\frac{OR}{OP}$ measures the total inefficiency. The distance RP is the cost reduction achievable which is obtained from moving from P (the observed point) to Q' (the cost-minimizing point).

With this approach, the effective unit isoquant cannot be recognized, it must be estimated on the observation sample. The approach is non-parametric

because Farrell simply constructs a Free Disposable Convex Hull (FDCH) of the observed input-output relationships using linear programme ming techniques that support a subset of the sample with the rest of the sample points above it.

According to Ning and You (2019) and Gottesman et al. (2019), the main advantage of the NPA is that no functional form is imposed on the data. A disadvantage of the approach is that the frontier value is calculated based on the associated subset of observations and is therefore particularly prone to extreme observations and measurement errors. Another shortcoming is that the estimated functions do not have statistical properties on which to conclude. However, recent events attempt to overcome this shortcoming.

Farrell's approach was followed by Charnes et al. (1978) which led to the so-called Data Envelopment Analysis (DEA). DEA envelops observed production possibilities to obtain an empirical limit (frontier) and to measure efficiency as a distance to the frontier. Efficient firms are compared to other firms in the test group. This approach generalizes Farrell's approach to the calculation of the efficiency frontier as a piecewise linear convex hull in the space of the input coefficients with several outputs. Charnes et al. (1978) reformulated Farrell's approach to calculating individual savings efficiency measures by solving the problem of linear programme ming for each unit assuming a Constant Return to Scale (CRS), while Banker et al. (1984) extended it to the Variable Returns to Scale (VRS), as imperfect competition means that financial constraints can prevent the firm from operating at optimal levels, an assumption on which CRS is reasonable. Charnes et al. (1978) proposed a model

that had input orientation. DEA can be viewed as a non-parametric approach to estimating distance functions (Banker et al., 2017).

Assuming there is data on K inputs and Q outputs on each of N firms. For the ith firm, these are represented by the vectors x_i and y_i, respectively. The $K \times N$ input matrix, X, and the $Q \times N$ output matrix, Y, represent the data of all M firms. The purpose of the approach is to construct a non-parametric envelopment frontier over the data points such that all observed points lie on or below the production frontier. The input-oriented constant returns to scale DEA frontier is defined by the solution to N linear programme s of the form:

$$\min_{\theta,\lambda} \theta$$

Subject to $-y_i + Y\lambda \geq 0$.....(9)

$\theta x_i - X\lambda \geq 0$

$\lambda \geq 0$

Where θ is a scalar and λ is a $N \times 1$ vector of constants. The value of θ is an index of technical efficiency for the ith firm and will satisfy $0 \leq \theta \leq 1$, with a value of 1 indicating a point on the frontier and hence a technically efficient firm, according to Farrell (1957) definition. Thus, $1 - \theta$ measures how much a firm's inputs can be proportionally reduced without any loss in output.

However, the assumption of CRS is correct only as long as firms are operating at an optimal scale (Coelli et al., 2005). Using the CRS DEA model when firms are not operating at their optimal scale will cause the technical efficiency measures to be influenced by scale efficiencies and thus the measure of technical efficiency will be incorrect. The CRS linear programme ming problem can easily be modified to account for variable returns to scale by adding

the convexity constraint: $N1'\lambda = 1$ to equation (9) to provide an input-oriented VRS model:

$$\min_{\theta,\lambda} \theta$$

Subject to $-y_i + Y\lambda \geq 0$ ……..……(10)

$\theta x_i - X\lambda \geq 0$

$N1'\lambda = 1$

$\lambda \geq 0$

Where $N1$ is a $N \times 1$ vector of ones. This approach forms a convex hull of intersecting planes that envelope the data points more tightly than the CRS conical hull and thus provide technical efficiency scores which are greater than or equal to those obtained using the CRS model. The output-oriented models are very similar to their input-oriented counterparts. For instance, the output-oriented VRS model is defined by a solution to N linear programme s of the form:

$$\max_{\emptyset,\lambda} \emptyset$$

Subject to $-\emptyset y_i + Y\lambda \geq 0$……..(11)

$x_i - X\lambda \geq 0$

$N1'\lambda = 1$

$\lambda \geq 0$

where, $1 \leq \emptyset \leq \infty$ and $\emptyset$ is the proportional increase in output that could be achieved by the ith firm, with input held constant. $\frac{1}{\emptyset}$ defines a technical efficiency score that varies between zero (0) and one (1). The CRS output-oriented model can be defined similarly by removing the convexity constraint, $N1'\lambda = 1$ from equation (11).

In input-oriented models, the method tried to identify technical inefficiencies as a proportional reduction in input usage. They are input-oriented and try to find out how the input properties of the company in question can be improved to become efficient. With the output-oriented measure, the technical inefficiency should be identified as a proportional increase in production. The input and output orientations deliver the same value within the CRS but are not equal under the assumption of the VRS. Input-oriented and output-oriented models, therefore, assess the same frontier and therefore, by definition, identify the same group of companies as efficient. Only efficiency measures associated with inefficient companies can distinguish between these two methods. Since linear programme ming cannot suffer from statistical problems such as the distortion of simultaneous equations, choosing the appropriate alignment is not critical. One should choose the orientation according to which the quantity (inputs or outputs) managers have the greatest control. In many cases, the choice of orientation has little effect on the results obtained (Battese & Coelli, 1995).

With the availability of pricing information, it is possible to consider a behavioral goal such as minimizing costs or maximizing revenue so that both technical and allocative efficiency can be measured. To minimize VRS costs, the input-oriented DEA model given in equation (10) should be run to achieve technical efficiency (TE). The next DEA to minimize costs would then start

$min_{\lambda,x_i^*} \; P_i{}' \, x_i{}^*$

Subject to $-y_i + Y\lambda \geq 0$……..(12)

$x_i{}^* - X\lambda \geq 0$

$N1'\lambda = 1$

$\lambda \geq 0$

Where P_i is a vector of input prices for the ith firm and x_i * is the cost-minimizing vector of input quantities for the ith firm given the input prices P_i and the output levels y_i and this is calculated by linear programme ming. The total cost efficiency (CE) or economic efficiency of the ith firm would be calculated as

$$CE = \frac{P_i{}' x_i{}^*}{P_i{}' x_i} \quad \text{.....(13)}$$

That is the ratio of the minimum cost to observed cost. One can then use equation (13) to calculate the allocative efficiency residually as

$$AE = \frac{CE}{TE} \quad \text{.....(14)}$$

This procedure includes all relaxations to the extent of the allocative efficiency. This is often justified because the relaxation reflects an inadequate mix of inputs (Lovell, 1993).

The aim of the DEA analysis is not only to determine the efficiency rate of the examined units but also to determine the target values for inputs and outputs for the inefficient unit. After reaching these values, the device would reach the efficiency threshold. The main disadvantage of the deterministic DEA approach is that it fails to take into account the potential effects of measurement errors and other noise in the data and, as such, provides biased estimates in the presence of measurement errors and other statistical noise.

However, its advantage is that no arbitrary assumptions about the functional form of the frontier and the distributional assumption of the fault element are required. With DEA, multiple output technologies can be tested very easily without aggregation. As mentioned earlier, one of the main disadvantages of nonparametric techniques is their deterministic nature. This

has traditionally led the literature on the subject to refer to them as non-statistical methods.

However, recent literature has shown that it is possible to define a statistical model with which statistical properties of NPA estimates can be determined (Asmare & Begashaw, 2018). For example, DEA models with stochastic variations have recently received attention (Chen et al., 2017; El-Demerdash et al., 2021; Tavassoli et al., 2020; Zadmirzaei et al., 2019; Z. Zhou et al., 2017). For example, Simar and Wilson (2020) methodically examined the statistical properties of DEA models and developed a bootstrap algorithm with which the statistical properties of efficiency estimates generated by DEA can be examined. Therefore, it could be concluded that statistical inferences based on NPA to measure economic efficiency are available either using asymptotic results or using a bootstrap. However, several other major issues need to be addressed, namely the high sensitivity of NPA to outliers, and the way in which stochastic noise can be accounted for in a NPA framework (Asmare & Begashaw, 2018; Romaniuk & Hryniewicz, 2019).

Parametric Approach

The parametric approach (PA) includes the specification of the functional form for the production technology and the assumption about the distribution of error terms. The main advantage of the parametric approach over the nonparametric approach is the ability to express the boundary technology in a simple mathematical form. However, the parametric approach establishes a boundary structure that may not be justified. The parametric approach often limits the number of observations that can be technically efficient. For example, in the case of a homogeneous Cobb-Douglas function using a linear programme

ming algorithm, there are generally only as many technically efficient observations as the parameters to be estimated (Asmare & Begashaw, 2018). This approach can be divided into deterministic and stochastic frontiers. The parametric deterministic approach is further divided into statistical and non-statistical methods.

Deterministic Non-Statistical Frontiers

Several studies followed Farrell's nonparametric approach. Farrell (1957) suggested a different approach almost afterward. In this approach, Farrell proposed the computation of the parametric convex hull of the observed input-output relationships. To this end, he recommended the Cobb-Douglas production function given the limited range of functional form. He recognized the undesirability of imposing a specific (and restrictive) functional form on a frontier but also pointed out the advantage of being able to express a frontier in a simple mathematical form. Farrell did not follow this suggestion.

Aigner and Chu (1968) were the first to follow Farrell's suggestion. To express the frontier in mathematical terms, they determined the Cobb-Douglas production frontier and required that all observations be at or below the frontier. The model can be written as:

$In\, y_i = In\, f(x_i; \alpha) - \mu_i; \quad \mu \geq 0$.....(15)

where y_i is the output of the ith sample firm, x_i are the inputs of the ith firm, μ_i is a one-sided non-negative random variable associated with firm-specific factors that contribute to the ith firm inability to attain maximum efficiency of production. The one-sided error term, μ_i forces

$y \leq f(x)$. The elements of the parameter vector α , may be estimated either by linear Programme ming (minimizing the sum of the absolute values of the

residues subject to the constraint that each residue is not positive) or quadratic programme ming (minimizing the sum of the quadratic residues subject to the same constraint). Although Aigner and Chu (1968) did not do this, the technical efficiency of each observation can be calculated directly from the residual vector, since μ represents the technical efficiency.

The main problem with this approach is that it provides estimates that lack statistical properties. That is, the programme ming process provides estimates without standard errors, t-ratios, etc. This is because in equation (15) no statistical assumptions are made about the regressors or the perturbation member and therefore no conclusions can be drawn.

Deterministic Statistical Frontiers

The previous models were critiqued for their lack of statistical properties. This problem can be addressed by making some assumptions about the disturbance term. The model in equation (15) can be written as,

$In\ y = f(x)e^{-u}$,……..(16)

Or

$In\ y = In[f(x) - u]$……..(17)

Where $u \geq 0$, implying $0 \leq e^{-u} \leq 1$, is linear in the Cobb-Douglas case presented in equation (17). Some assumptions are usually made about u and x and that is, u are independently and identically distributed (iid), with mean μ and finite variance and that x is exogenous and independent of u. Any number of distributions for $u(or\ u$ (or e^{-u}) could be specified. Aigner and Chu (1968) did not explicitly assume such a model though it seems clear it was assumed implicitly.

However, the first to explicitly propose this type of model was Afriat (1972), who proposed a two-parameter beta distribution for e^{-u}, and that the model be estimated by maximum likelihood method. This amounts to gamma distribution for u, as considered further by Richmond (1974). On the other hand, Schmidt (1976) has demonstrated that if u is exponential, then Aigner and Chu's linear programme ming procedure is a maximum likelihood, while their quadratic programme ming procedure is a maximum likelihood if u is half-normal.

In the frontier setting, there are some problems with maximum likelihood. First, maximum likelihood estimates (MLE) depend on the choice of distribution for u such that different assumptions yield different estimates. This is a problem because there are no good a priori arguments for the choice of any particular distribution. Second, the range of the dependent variable (output) depends on the parameters to be estimated (Schmidt, 1976). This is because $y \leq f(x)$ and $f(x)$ involve the parameters which are to be estimated. For any one-sided error distribution, $y \leq f(x)$ violates one of the usual regularity conditions for consistent and asymptotic efficiency of maximum likelihood estimators (namely, that the range of the random variable should not depend on the parameters). Thus, the statistical properties of the MLE's are in general uncertain. Greene (1980) finds sufficient conditions on the distribution of u for the MLE's to have their usual desirable asymptotic properties:

i. if g is the density of u , $g(0) = 0$, i.e. the density of u is zero at $u = 0$ and

ii. $g'(u) \to 0 \; as \; u \to 0$, i.e. the derivative of the density of u to its parameters approaches zero (0) as u approaches zero (0). However, as

Schimdt (1986) noted, it is not desirable that one's assumptions about the error term be governed by the need to satisfy such conditions.

An alternative method of estimation based on ordinary least squares was first proposed by Richmond (1974) and is called corrected OLS or COLS. Suppose equation (17) is assumed to be linear (Cobb-Douglas) and letting μ be the mean of u , then

$$In\ y = (\alpha_0 - \mu) + \sum_{i=1}^{n} \alpha_i\ In\ x_i - (u - \mu) \quad \text{.....(18)}$$

Where the new error term has zero mean. Since the error term satisfies all the usual ideal conditions except normality, equation (18) can be estimated by OLS to obtain the best linear unbiased estimates $(\alpha_0 - \mu)$ and of α_i . If a specific distribution is assumed for u, and if the parameters of the distribution can be derived from higher-order (second, third, etc.) central moments, then these parameters can be consistently estimated from the moments of the OLS residuals. Since μ is a function of these parameters, it can also be estimated consistently, and this estimate can be used to correct the OLS constant term, which is a consistent estimate $(\alpha - \mu)$. Thus, COLS provides consistent estimates of all the parameters of the frontier. However, this technique poses some difficulties. First, some of the residuals may still have wrong signs after correcting the constant term so that these observations end up above the estimated production frontier. This makes COLS seem not to be a very good technique for computing the technical efficiency of individual observations. There are two ways of resolving this problem namely, by use of stochastic frontier approach or to estimate equation (18) by OLS, then correct the constant term not as above, but by shifting it up until no residual is positive, and one is zero. Another difficulty with the COLS technique is that the correction to the

constant term is not independent of the distribution assumed for u. That is, different assumptions yield systematically different corrections for the constant term, and systematically different estimates of technical efficiency, except for the special case var (u) =1. However, this problem again can be resolved by shifting the function upward until no residual is positive, and one is zero.

Stochastic Frontier Model

They showed up an improvement in the average functions and the deterministic frontiers. At deterministic boundaries, all fluctuations in firm performance are attributed only to changes in firm efficiency compared to a common family of boundaries, regardless of whether it is production, cost, or profit margins. The idea of a deterministic boundary shared by all firms, therefore, neglects the very real possibility that firm performance will be influenced by factors that are completely beyond their control, such as bad weather, supply outages, among others as well as factors that are under their control (inefficiency). The combination of these effects of exogenous shocks, along with the effects of measurement errors and inefficiency into a one-sided error term and characterizing the inefficiency of the mixture is questionable and the main weakness of deterministic boundaries (frontier).

Førsund et al. (1980) observed that this conclusion is reinforced if the statistical noise contained in each empirical relationship is also taken into account. The standard interpretation is that there may be an error in measuring the dependent variable. Second, the equation may not be listed in its entirety with omitted variables that are individually irrelevant. These two arguments hold as well for production functions as they do for any kind of equation, and it is doubtful at best not to distinguish this noise from inefficiency, or to assume

that the noise is one-sided. On this basis, the stochastic frontier model was independently suggested by (composite error) by (Aigner & Chu, 1968)

The key idea behind the SFM is that the disturbance term consists of two parts. The symmetrical component allows the boundary between the enterprises to be changed randomly and records the effects of measurement errors, other statistical disturbances, and random shocks that are beyond the control of the enterprise. The one-sided component records the effects of the inefficiency on the stochastic frontier.

The stochastic frontier function may be defined according to Battese and Coelli (1995) as:

$y_i = f(x_i, \alpha) \exp(\varepsilon_i), i = 1, \ldots N$ .....(19)

Where $\varepsilon_i = v_i - u_i$ .....(20)

The stochastic frontier is $f(x_i, \alpha) \exp(v_i)$, is the output of the ith firm and is bounded above by the stochastic quantity, x_i are the inputs of the ith firm. ε_i is a random variable. v_i is the random error having zero mean, and is associated with random effects of measurement errors and exogenous shocks that cause the deterministic kernel $f(x_i, \alpha)$ to vary across firms. Technical inefficiency is captured by the one-sided error component $\exp(-u_i)$, where $u_i \geq 0$ implying that all observations must lie on or beneath the stochastic production frontier.

The random errors, v_i were assumed to be independently and identically distributed as $N(0, \sigma^2)$ random variables and independent of the u_i 's, which were assumed to be non-negative truncations of the half-normal distribution i.e., $[N(\mu, \sigma_u^2)]$ or exponential distribution i.e. $EXP(\mu, \sigma_u^2)$. Aigner et al. (1977) considered half-normal and exponential distributions but Meeusen and

van den Broeck (1977) considered exponential distribution only. Stevenson (1980) has shown how the half-normal and exponential distributions can be generalized to truncated normal $\{N(\mu, \sigma_u^2)\}$ and gamma distributions, respectively. There was a tendency for researchers to use the half-normal and truncated normal distributions probably because of ease of estimation and interpretation and more so, as there were no standard tests for distribution selection. However, Lee (1983) proposed a Lagrange-Multiplier test to assess different distributions for the inefficiency term. Given the assumptions of the stochastic frontier model (19), inference about the parameters of the model can be based on the maximum likelihood estimators because the standard regularity conditions are satisfied.

The technical efficiency of an individual firm is defined in terms of the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by that firm. Thus, the technical efficiency of firm i in the context of the stochastic production function expressed in equations (19) and (20) is given as

$$TE_i = \frac{y_i}{y_i^*} = \frac{y_i}{f(x_i;\alpha)exp\,(v_i)^*} = \exp(-u_i) \quad \text{..... (21)}$$

The prediction of technical efficiencies of individual firms associated with the stochastic frontier production function (19) was considered impossible until the appearance of Jondrow et al. (1982). Following Jondrow et al. (1982) and Battese and Coelli (1995) parameterization, the firm-specific technical efficiency can be predicted by the conditional expectation of the non-negative random variable,u_i given that the random variable, ε_i , is observable. The technical efficiency of the ith firm is then given by:

$$E(u_i/\varepsilon_i) = \frac{\sigma_u\sigma_v}{\sigma}\left[\frac{f(.)}{1-F(.)} - \frac{\varepsilon_i}{\sigma}\left(\frac{\Upsilon}{1-\Upsilon}\right)^{\frac{1}{2}}\right] \quad \text{.....(22)}$$

Where ε_i are the estimated residuals for each firm, $f(.)$ and $F(.)$ are the values of the standard normal density function and standard normal distribution function, respectively, evaluated at $\frac{\varepsilon_i}{\sigma}(\frac{\gamma}{1-\gamma})^{\frac{1}{2}}$. The parameters of the model, i.e. α, = $\sigma^2 + \sigma_u^2$ can be obtained from the maximum likelihood estimation of equation (22). γ is bounded between zero and one and it explains the total variation of output from the frontier which can be attributed to technical inefficiency. The estimates of v_i and u_i can be obtained by substituting the estimates of ε_i, γ, and σ. Thus, the technical efficiency of individual firms can be measured as $TE_i = \exp(-E(u_i/\varepsilon_i)$ which represents the level of technical efficiency of the ith firm relative to the frontier firm. However, Battese and Coelli (1988) derived the best predictor of TE given as $E(u_i/\varepsilon_i) = \left[\frac{1-F(\sigma_A+\gamma\varepsilon_i/\sigma_A)}{1-F(\gamma\varepsilon_i/\sigma_A)}\exp(\gamma\varepsilon_i + \sigma_A^2/2)\right]$

One can test whether any form of stochastic frontier production is needed at all by testing the significance of the γ parameter. If the null hypothesis, that γ equals zero, is accepted, this would indicate that σ_u^2 is zero and hence that the u_i should be removed from the model, leaving a specification with parameters that can be consistently estimated using ordinary least squares Coelli (1996).

There are two approaches to estimating inefficiency effect models, namely the second part of the SFMs, which explains differences in firm efficiency. It can be assessed in either a one-step or a two-step process. In a one-step process, estimates of all parameters are obtained in one step. The effects of inefficiency are defined as a function of firm-specific factors (as in the two-step approach) but are then incorporated directly into the MLE. That is, both the

production frontier and the models of inefficiency effects are assessed simultaneously.

For the two-step process, the production frontier is first estimated and the technical efficiency of each firm is carried out. They are then fed back according to the set of variables that are believed to affect the firm's efficiency. The two-step process has been criticized for inconsistencies in the assumptions about the distribution of inefficiencies. This is because the first phase assumes that the inefficiencies are independently and identically distributed to estimate their values. In the second phase, however, it is assumed that inefficiencies are a function of several company-specific factors and are therefore not distributed identically unless all factor coefficients are equal to zero at the same time (Pascoe et al., 2018; Van Nguyen et al., 2021).

Therefore, the distribution assumptions used in each step are contradicting (Coelli et al. (2005). Badunenko and Kumbhakar (2017); Kumbhakar and Lovell (2000); Lien et al. (2018); Yao et al. (2019) and Zhou et al. (2020) argued that estimated technical coefficients and technical efficiency indices are biased if technical efficiency determinants are not taken into account in the first step of the regression. They provided a one-step process to determine the impact of socio-economic variables on technical efficiency while estimating the technical coefficients of the production limit. Kannaki and Louis (2020), on the other hand, defended the practice of two-stage regression because socio-economic variables have a circular effect on production.

Although the two-step process has been criticized for producing biased results, there appears to be little evidence of the severity of this bias. For example, Simar and Wilson (2020) provide indications of biases in estimated

technological parameters, but not of efficiency levels or their relationship to variable explanations. However, Wang and Alvi (2011) identified two sources of bias, namely that the first step of a two-step process is biased for regression parameters when z and inputs x_i are correlated. Second, even if z and x are independent, the estimated inefficiencies are not sufficiently distributed if the impact of z on inefficiency is neglected. As a result, the effect of z on inefficiency in the second step deviates downwards (towards zero). Therefore, they suggested using a one-step process to overcome this problem. It appears there is no consensus in the literature on using the one-step or two-step process, and the choice may only be the analyst's choice.

The Cobb-Douglas functional form is normally used to estimate the stochastic production frontier. While its simplicity is its most attractive feature, it comes with several limitations. The most important thing is that the return on the scale has the same value in all firms in the sample and that the elasticity of substitution is assumed to be equal to one. However, more flexible functional forms such as the translog production function were also considered.

The form of the translog does not limit the return to the scope or the possibilities of substitution but has the disadvantage that it is subject to multicollinearity and problems with the degree of freedom Coelli et al. (2005). In either case, the choice of the appropriate form of function can be made by performing a test of the likelihood relationship between competing models.

Stochastic Frontier Analysis (SFA) has both advantages and disadvantages. Firstly, random unnoticed heterogeneity between firms is controlled. The effect of inefficiency can be separated from statistical noise. With nonparametric methods, any deviation in the observation from the frontier

value must be attributed to inefficiency, which makes the results very sensitive to deviations or errors in the measurement and uncertainty.

Second, the SFA can be used to test the statistical significance of efficiency-determining variables through statistical tests, although this is also true for newer DEA models. Third, a firm's specific inefficiency is not measured in terms of the "best" firm, as is the case with nonparametric approaches. Therefore, SFA is again less sensitive to variations in the sample. The disadvantages of the SFA approach are the need for distribution assumptions for the two error components and the assumption of independence between the error term and the regressor. In addition, the application of the model requires the choice of an explicit functional form, the adequacy of which raises questions.

The stochastic frontier specification has been modified and expanded in various ways. These extensions include: checking the panel data and time-varying technical efficiency, extending the methodology to cost, revenue, and profit margins, estimating stochastic input-output distance functions, estimating systems of equations, and decomposing cost margins to take into account both technical and allocative efficiency. Banker et al. (2017) provide an overview of most of these extensions.

Theoretical Literature on Public Debt

This section highlights the major theories of public debt. Specifically, the section explains the classical, the neo-classical, the modern theory, Keynesians, and the post-Keynesian theories on public debt.

Keynesian View on Public Debt

Standard economic literature suggests that countercyclical fiscal policy should be implemented during the economic slowdown and rise in public debt, and its reduction during an economic expansion (Barro, 1979). The Keynesian school of thought, therefore, justified increasing the national debt as a means of stabilizing the economy, which meant that the government must always have some form of debt (Keynes, 1937). This principle attracted some attention from political researcher Lorenz von Stein, who argued that "a government with no public debt either does too little for its future or demands too much of its present" (von Stein, 1871).

Classical and Neoclassical View on Public Debt

In contrast, classical believed that public debt would negatively affect the economy because such spending was unproductive and wasteful for them (Smith, 1776). The neoclassical also criticized national debt for the crowding-out effect on investment, persistent interest-sensitive spending, and, consequently, the indirect reduction in consumption through the wealth effect (Friedman, 1978). At a time when revenues are insufficient to cover expenses, governments are forced to fund this deficit through various funding options, including lending. The decision for home or outside financing depends on the costs and risks associated with each option (Mothibi & Mncayi, 2019).

In particular, the decision to fund expenses by borrowing creates additional costs that require the payment of interest and principal in future fiscal years (Amu et al., 2021), and over time, borrowing will increase the cost of public debt. Although lending is justified from a national perspective and as such can play an important role in economic progress (Wang & Perkins, 2019),

borrowing too much can lead to economic problems, especially when growth and income are not enough to repay debt produce required resources (Owusu, 2019; Senga, 2019; Vaggi & Frigerio, 2021).

The "Conventional" View on Public Debt

The view currently assumed by most economists is the "conventional" view on the public debt (Elmendorf & Mankiw, 1999). This combines classical (liberal) and Keynesian arguments, distinguishing between the effects of public debt on economic growth over the short, medium, and long term. In the short term, the framework of analysis is considered to be Keynesian, so the supply of goods and services and output appear to be determined by the level of demand, which at its turn can be influenced by public borrowing to finance increased budget deficits. So, public indebtedness can prove to be beneficial for the economy over the short term, especially when the economy is in recession or confronted with weak growth rates, and when the actual GDP is well below its potential level.

In the long term, the framework of analysis is considered to be classical, so the impact of the demand becomes less relevant and what matters for economic growth, on the contrary, is the supply of factors of production. The indebtedness of public authorities, to finance budget deficits, is considered to result in the reduction of total (public and private) savings, the increase of the interest rate, the decrease of investments, and the reduction of capital stock. Thus, its effects on economic growth appear to be mostly negative.

Theoretical Literature on Income Inequality

One of the theories linking income inequality and public spending is the Keynesian theory of employment, interest, and money. Keynes' theory is

relevant because of concerns about the role of government in the economy. According to Stack (1978) “Keynes' theory explains fluctuations in employment rates and economic growth. In turn, they can be applied to the problem of income inequality (the higher the employment and growth rate, the lower the inequality).”

In Keynesian theory, the government could increase the likelihood of achieving the basic goal of balancing savings, spending, and investment. The level of employment, which is a key factor in measuring income inequality, depends on the good and demand for the service. Stack (1978) found that “demand is a function of the relative propensity to consume and the propensity to save. If the amount of money saved by the income recipients is greater than the amount claimed by those responsible for the investment, the aggregate demand will not be sufficient to maintain full employment. "Excessive savings are therefore not good for the economy as they reduce job creation and create the problem of unemployment, which leads to higher income inequality (Stack, 1978).

The government can develop strategies that balance savings, spending, and investment. These government measures include government spendings such as social security programme s, subsidies, and welfare expenses that could affect low-income households. In addition, the ability of the government to create jobs such as public works and government-industry could also lower the unemployment rate and ultimately reduce income inequality (Stack, 1978). Also, Stack (1978) suggests that government involvement through job creation programme s could have a multiplier effect. The job creation programme not

only creates higher productivity but also more money that can be reinvested in the public or private sector.

The theory, therefore, suggests that government participation in the economy could improve income inequality and poverty. First, certain types of government spending could ease restrictions and improve the living standards of low-income households. Second, the more jobs that public construction projects create, the lower the unemployment and the lower the inequality and poverty. Third, the multiplier effects of job creation programme s could lead to increased economic activity and multiple investments. The impact of such government spending, job creation, and the multiplier effect all contribute to economic growth. "This, in turn, promotes a climate that favors the redistribution of income, since the rich can reduce their relative share of income and at the same time increase the absolute amount of real income" (Stack, 1978).

Theoretical Link between Public Spending Efficiency and Public Debt

Theoretically, efficiency of public spending is expected to improve public debt and make it sustainable. This is because efficiency reduces wastage which leads to a decrease in government spending hence a reduction in debt. Efficiency in public investment economic growth which reduces the debt to GDP ratio (Arrow & Kurz, 1970). Angelopoulos et al. (2008) confirms a negative relationship between efficiency and public debt. Barro (1996) classifies government expenditures as consumption and investment. All non-productive spending can slow long-term real GDP per capita growth, according to empirical evidence. As growth slows, debt increases.

Bleaney et al. (2001) loosen the assumption of exogenous government expenditures. They construct an optimization problem with productive and

wasteful expenditures. They conclude that there is an ideal level of productive spending in an economy, over which such expenditures might have a detrimental influence on economic growth owing to over-investment in capital and declining returns to scale. The study showed that at low efficiency, a growing public sector reduces growth and that an efficient public authorities are more successful in setting up and implementing consolidated programmes. Years later, Agénor (2009) investigated a similar approach. They studied the best allocation of public spending among health, education, and infrastructure, including the inter-sector dynamics.

There are two elements in this hypothesis. A first one is that the same consolidation programme will be more effective in bringing down the public debt ratio when it is adopted by a more efficient government apparatus. Private agents may then see the programme as more credible, and believe it to be more durable. A second element is that more efficient governments adopt better consolidation programmes when it comes to size and composition.

Theoretical Link between Public Spending Efficiency and Income Inequality

Theoretically, various factors are associated with the incidence of poverty and income inequality. Among them are public spending efficiency on health and education. Poor health status adversely affects the welfare of people since they cannot perform well in life. Meanwhile, a healthy person tends to have higher human capital and productivity than a poor health one. Since health status is strongly associated with the welfare of the households (Castro-Leal et

al., 1999); therefore, an increase in the health of the workforce and infrastructure spending is negatively correlated with the poverty level.

Regarding public education spending efficiency, there is a general presumption that this type of public spending could reduce inequality and poverty problems. When the government efficienctly devotes more fund to education, it increases the school enrolment rates of low-income people since education becomes more affordable (Lokshin & Yemtsov, 2005). Eventually, a better education leads to higher human capital, and increasing the human capital of low-income people is one of the solutions to reduce income inequality and poverty.

Empirical Literature

There are several works conducted on the efficiency of public spending, public debt, and income inequality. This section presents literature on empirical studies conducted on the efficiency of public spending, public debt, and income inequality. It is also interesting to note that, the literature is silent on the role of public spending efficiency on public debt and income inequality.

Empirical Literature on Efficiency of Public Spending

It is interesting to note that, studies on spending efficiency have centered on Europe, Latin America, and Asia with little emphasis on Africa. For instance, Kosor et al. (2019) covered 28 European countries on the effectiveness of public spending on higher education. The study concentrated on European higher education as well as the conceptual and methodological issues related to measuring and analyzing efficiency. The study identified the most efficient countries as well as countries for which real efficiency improvements are possible. A new set of variables were used to more appropriately highlight the

specificity of the higher education sector and the relationship between inputs and outcomes.

Using the DEA and the latest available data, the study found that average spending efficiency is high, although there were large differences between countries in efficiency ratings. The study identified Bulgaria, Hungary, Ireland, Luxembourg, and Malta as the five most efficient countries. Even though this study makes a great contribution to literature, there are data limitations preventing researchers from making functional cross-country comparisons. Although great care was taken in the selection of variables, measuring the efficiency of public spending on higher education is still a challenging undertaking.

Fonchamnyo and Sama (2016) analysed the efficiency of public spending in the education and health sectors in Cameroon, Chad, and the Central African Republic. The institution and economic factors influencing the efficiency of spending in these sectors in the countries selected for the period 2000–2012 were also examined. The public sector efficiency assessments were assessed in the first phase using a non-parametric approach to Data Envelopment Analysis (DEA), while in the second phase, the Tobit model and fractional logit regression techniques were used to assess the factors affecting efficiency of public spending in education and health. The results of the assessment showed that Cameroon is more efficient than Chad and the Central African Republic in terms of public spending on education and health. Chad was the least efficient in terms of public spending on education, although it spends more on education compared to other countries in the study.

The results also showed that the quality of budgetary and financial management has a positive and statistically significant impact on efficiency, while corruption has a negative and significant impact on the efficiency of public spending on education and health. The study recommended that efforts to fight corruption and improve the quality of budget and financial management must be in place. Even though the study contributed greatly to literature, it is not devoid of limitations. The study calculated the averages of the input and output variables to estimate the efficiency scores which fails to give a real picture of the trend of efficiency scores for each country across time. Even though the study concentrated on some African countries, the data used spans from 2000 to 2012 which is nine years ago. This demands that recent data be used to determine new development in the efficiency of public spending in Africa.

Also, Ouertani, Naifar, Ben Haddad, et al. (2018) assessed the efficiency of government spending on education, health, and infrastructure, and provided estimates of inefficiencies using the DEA bootstrap in the case of Saudi Arabia. The paper had two goals. First, to measure the relative efficiency of Saudi Arabia's public spending over the period 1988-2013 using a non-parametric approach. Second, explain the results of inefficiencies using DEA bootstrap analysis by including environment variables.

The result indicated that, on average, public spending is inefficient, which means Saudi Arabia can improve its health, education, and infrastructure performance without increasing spending. An empirical explanation of the inefficiency results using the DEA bootstrap analysis showed that unemployment and broad money negatively impact government spending,

mainly in the case of infrastructure and health care. The results can be useful for policymakers to develop a structural adjustment plan to improve the efficiency of education, health, and infrastructure costs although the study is based on average efficiency scores instead of the trend to ascertain whether efficiency in public spending has been improving time or decreasing over time.

Added to the above studies, Iskandar (2019) also assessed the effectiveness of the regional government's spending on health and education in Indonesia during the public finance decentralization period 2010-2017. In this paper, efficiency scores were calculated using a sample of 33 provinces by setting nonparametric thresholds that were assessed and quantitatively analysed by Data Envelopment Analysis (DEA). The results showed that the provinces of the western regions: Bali, Bangka Belitung, DI Yogyakarta, Central Java and Kepulauan Riau had relatively most efficient public spending on both health and education during the study period. DKI Jakarta and West Java had efficient spending only on health, and Bengkulu had an efficient output only on education. Gorontalo, Central Kalimantan, East Kalimantan, and North Sulawesi, on the other hand, had the most efficient public spending on health and education services among the provinces of the eastern regions.

Maluku and Southeast Sulawesi only had efficient health spending, while South Kalimantan, North Maluku, West Nusa Tenggara, and West Sulawesi spent efficiently on education. It was concluded that the provinces in the eastern region of Indonesia have been relatively more efficient in public spending on health and education to promote an even distribution of income from the provinces in the western region. It is interesting to note that, this study

did not investigate the causes of inefficiency in public spending to enable policymakers devise appropriate strategies to mitigate it.

Again, Mohanty and Bhanumurthy (2018) attempted to measure the efficiency of government spending on the social sector, particularly health and education, among Indian states using various DEA approaches. In addition, the paper sought to understand what drives the efficiency of public spending among states. The results suggest that states spend their resources more efficiently on education than on health and all of the social sector spending. It also found that both the quality of governance and economic growth affect the effectiveness of education, health, and the social sector, with governance having a greater impact than growth. Overall, the study suggests that a focus on good governance could lead to better results in public spending.

Added to the above, Smaoui and Kammoun (2019) also argued that the education sector generates economic growth with appropriate use of the allocated costs. Therefore, the mission of the university is no longer limited to the production and dissemination of knowledge and skills but extends to training and professional integration. For this reason, public spending on educational services is a very important part of total public spending in Tunisia. Using the DEA (Data Envelopment Analysis) model and higher education data to calculate efficiency scores for the 1971/2015 period, the study found that educational services are inefficient and therefore public spending in these sectors is not of good quality. For this reason, the authorities need to introduce new and more transparent practices in the management of public spending to achieve educational objectives.

Herrera and Ouedraogo (2018) also assessed the effectiveness of government spending on education, health, and infrastructure in rich and poor countries. In this article, efficiency is measured as the distance between observed input-output combinations and the efficiency frontier, estimated using free disposal hull techniques and data envelopment analysis. In a sample of 175 countries, input inefficiencies (excessive input consumption to achieve the output level) and output inefficiencies (lack of output for a certain input level) are measured using data from 2006–2016 on education, health and Infrastructure recorded.

The article examines the empirical laws of efficiency fluctuations in different countries and shows a negative correlation between efficiency and consumption as well as the relationship between public and private financing of service provision. Other variables such as inequality, urbanisation, and dependency showed mixed results. The efficiency of investments correlates with the quality of the management indicators, in particular the quality of the regulations (positive) and the perception of corruption (negative). Although causality cannot be inferred from this exercise, it points to various factors to help understand why some countries would need more resources than others to achieve similar results in education, health, and infrastructure.

Dutu and Sicari (2016) also contributed by using Data Envelopment Analysis (DEA) to assess the effectiveness of social spending in a sample of OECD countries around 2012, with an emphasis on health care, secondary education, and general public services. The DEA model has two output structures, one input structure, with at least one variable representing a complex indicator that controls country-specific factors (e.g. socio-economic

environmental, and lifestyle factors). The study revealed a wide distribution of efficiency measures in the OECD countries and provided possible quantified improvements for both output and input efficiency.

Afonso and Kazemi (2017) looked at the public spending of 20 OECD countries for the period 2009 to 2013 from an efficiency perspective. The study produced indicators of public sector performance and public sector efficiency and used data envelopment analysis (DEA). The results showed that the only country performing at the efficiency frontier were Switzerland, Canada, Japan, Luxembourg, and the United States, which were also more efficient. The average input-oriented efficiency value is 0.732. That is, states were able to cut public spending by an average of 26.8% and still get the same public performance. The average efficiency-based score is 0.769, which means that the countries in the sample increased their performance by an average of 23.1% using the same public spending.

Ahec Šonje et al. (2018) examined the effectiveness of public spending on secondary and higher education in the new Member States (NMS) in the EU. DEA was used to assess the relative technical efficiency of public spending on secondary and higher education in the new Member States, with a particular focus on Croatia. The input variables are public spending on education per student and as a percentage of total spending on education, while the output variables for secondary education are PISA scores and the percentage of unemployed in tertiary education with tertiary education and the ranking of leading national universities in Shanghai. The results showed that inefficiency is high for public spending on education in Croatia.

Munoz (2016) conducted a study to assess the effectiveness of research by Chilean higher education institutions. The data envelopment analysis was used to assess the research effectiveness of several Chilean universities. Four models based on different parameters have been proposed to cover different drivers of research productivity. The paper provides evidence that few universities in Chile are research efficient. In addition, interesting results were found regarding the differences in efficiency between traditional universities and private universities. Universities with a mixed funding structure were more efficient than public and private universities. In addition, universities that are directly funded by the government are on average 3.3 times more efficient than private universities. According to the models, only one private university appeared in the top 10 based on the ranking of research efficiency.

Adil et al. (2016) presented a study measuring the effectiveness of selected Asian countries. A non-parametric approach to data analysis was used, encompassed by an input-driven, constant return-of-scale (CRS) approach, was used to measure technical efficiency for the 2012 period. Using the CRS-DEA model, 11 of the 26 countries were found to be efficient. The study provides suggestions for increasing the efficiency and productivity of these Asian countries.

Hamidi and Akinci (2016) conducted a study to measure the technical efficiency of twenty health systems in the MENA region for the period 1995-2012 using a stochastic frontier analysis (SFA). The authors tested the effect of specifying the alternative frontier model using three approaches to random effects. They found that the average efficiency in the region was 6.9% and was between 5.7 and 7.9% for all three models. The results showed that Lebanon,

Qatar, and Morocco had the highest scores, while Sudan, Yemen, and Djibouti were among the worst.

Government Spending and Public Debt

The empirical literature has also assessed extensively the relationship between government debt and government spending. Iiyambo and Kaulihowa (2020); Mah et al. (2013); Onyango (2019); Uguru (2016) reported a positive relationship between public spending and public debt. Iiyambo and Kaulihowa (2020) focused on the response of public debt to tax revenue and government spending in Kenya from 1960 to 2012. The study used a vector error correction model with correlation analysis as a data analysis tool. The study found a significant positive long-term relationship between government debt and tax revenue and government spending. Similarly, Uguru (2016) examined the relationship between government debt and government spending in Nigeria from 1980 to 2013, reporting a positive relationship between government spending and government debt. This finding is in line with Onyango (2019) who examined the impact of total government spending and debt on taxes in Namibia from 2001 to 2014.

Although the results agree with the public spending theory, the direction of causality has not been determined. Mah et al. (2013) tried alternatively to determine the effects of government spending and government revenue on government debt in Greece from 1976 to 2011 using a vector error correction model. Similar to the studies by Uguru (2016), the study also found a significantly positive relationship between gross national debt and gross social spending, but a negative relationship between gross national debt and gross

national income, with the Causality from the gross national results in public spending and gross national income on government debt.

Other studies such as Oladokun (2015) empirically investigated the cause-and-effect relationship between public spending and government debt using time series data from 1981 to 2012. Granger's causal test found that public spending causes domestic debt. Kanano (2006), on the other hand, also examined the determinants of growth in public spending in Kenya using the time series analysis technique for the period 1980-2004 using the OLS estimation method. The results showed a positive association between domestic debt and public spending, a negative association between external debt financing and public spending, and a strong positive association between government revenue and public spending.

In contrast, Achieng (2012) conducted a study to determine the relationship between the budget deficit and domestic debt in Kenya in the twenty years from 1991 to 2010 using multiple regression analysis. A positive correlation was found between the budget deficit, government spending, government revenue, and domestic debt. Although the methodology of the study differs from that of Kanano (2006), the results are also similar in Kenya.

Other Determinants of Public Debt

The existing literature shows that public debt is mainly influenced by a combination of macroeconomic, socioeconomic, institutional, and structural factors. However, it is often unclear whether public debt is driven by exogenous or endogenous factors (Karia, 2021; Mothibi & Mncayi, 2019).

Economic growth has a major impact on public debt. Since GDP measures an economy's ability to repay debt, increased production capacity and

the resulting income imply a greater ability to repay debt (Wang & Perkins, 2019). Low economic growth combined with low revenues (which can result from a low tax base) therefore leads to lower tax revenues, forcing the government to use debt to finance spending (Almenberg et al., 2020; Lin et al., 2019).

Similarly, the growing budget deficit is a significant part of the rise in the public debt ratio (Omrane Belguith & Omrane, 2017). The deficit is added every year to the debt stocks of the previous year (Mothibi & Mncayi, 2019) so that the national debt situation increases as the deficit increases, which means higher interest payments.

The credibility of monetary and fiscal policy is also one of the important factors determining the level of public debt. When the credibility of a country's policies is considered uncertain, debt securities are sold, often putting pressure on rising interest rates. This will ultimately increase the cost of government bonds. These increased financing costs increase the public debt due to higher interest payments (OECD, 2017) As a result, the public debt is higher than at lower interest rates (Fourie & Burger, 2010).

Inflation is another factor influencing public debt through higher nominal interest payments (Akitoby et al., 2017; Gomez-Gonzalez, 2019). Rogoff (2021) found that higher levels of debt are associated with significantly higher inflation rates in emerging markets. Abbas et al. (2013) argue that higher inflation essentially helps deleverage by reducing the real value of public debt.

Political factors include factors that can cause budget outcomes to deviate from optimal levels, particularly in developing countries (Natalia, 2006). Political instability, in particular, can feel a country's deficit, and Henisz

(2000) argues that this is possible because of market uncertainties about the country's debt settlement prospects and the quality of political institutions. As public debt increases, there are uncertainties about the policies the government will use to meet its debt service obligations, which has a negative impact on investment (Clements et al., 2003).

Currency fluctuations also have a negative impact on public debt, especially debt denominated in foreign currencies. According to Boshoff and Fourie (2020), a devaluation of the national currency against the currency in which the loans are taken out means that the external debt has increased, which in turn increases the real debt burden (Holtfrerich, 2018). This exchange rate channel can also be linked to trading conditions, which has a negative impact on countries that are highly dependent on primary exports, as these exports are prone to shocks (Mothibi & Mncayi, 2019; Van Cauwenbergh & Laleman, 2018).

Demographic factors such as population also put pressure on public debt by influencing consumption, especially when the consumption structure is distorted by a large proportion of current consumption (OECD, 2017). According to Kim and Lim (2018), the increase in younger age, in contrast to the increase in the older population, is associated with increased consumption and significantly higher external financing. This is especially true when the government has limited tax revenues, unemployment is high, and the number of people receiving social assistance (Kalaja & Vokshi, 2015).

Atta-Mensah and Ibrahim (2020) analyzed and explained the development of African debt over the last few decades and used statistical analyzes. They found that interest rate and growth differentials are the main

drivers of overall debt dynamics in African economies. Fatás (2019) based on a research analysis found that intertemporal tax breaks, fiscal incentives, and asset management can explain an increase in public debt in recent years. Sadik-Zada and Gatto (2019) examined the main drivers of government debt growth in 184 countries. The authors used a panel data approach. Their results showed that oil wealth, the economic growth rate, the share of mineral rent in total income, interest payments on foreign loans, and development as a developing country have a statistically significant influence on the growth of national debt, while defense spending, the unemployment rate, and the inflation rate do not have a statistically significant positive influence on the national debt ratio.

According to Chiminya and Nicolaidou (2015), who examined the determinants of external debt in sub-Saharan Africa using pooled OLS and fixed effects, countries that received debt relief appear to accumulate less debt than those that did not. Their results also highlighted the importance of economic activity in deleveraging in the region. Economies that are more open to international trade are reducing their debt burdens. Forslund et al. (2011) analyzed the determinants of public debt composition in developing and developing countries. The authors found a weak correlation between inflation and the composition of public debt. For Bayale et al. (2020) election events are positively related to the national debt in Africa when the GMM estimator is used.

A study that focused on twelve (12) European countries from 2000 to 2014 carried out by Gargouri and Keantini (2016) identified the determinants of European public debt. The study used a correlated model of corrected standard errors in panels. The results confirm the constancy of the dependent

variable that represents the debt ratio. The study found a positive impact from non-performing loans, military spending, and imports from banks, as well as a negative impact on GDP growth and banks' liquidity reserves.

Phillips and Shi (2019) carried out a study aimed at identifying the main determinants of public debt and how it is changing. The study analyzed 28 EU countries from 1995 to 2017 and concluded that the debt ratio is significantly and positively influenced by the previously accumulated national debt, but also by unemployment and population size, while real GDP growth, foreign direct investment, gross investment, and trade balance have a significant impact on limiting government debt.

Jeon and Oh (2020) provide evidence of a significant international co-movement in public debt in the form of common global and regional factors. International events such as the global financial crisis and the regional sovereign debt crisis suggest global and regional factors that can lead to synchronization of public debt in different countries. In contrast to previous studies, which mainly focused on domestic economic fundamentals when explaining public debt, this paper identifies various global factors for the ratio of public debt to GDP, both from the analysis of the main components and the Bayes model of the dynamic factor. The study showed that the global factor accounts for a significant proportion of the fluctuations in public debt, which in many countries are often more significant than those explained by domestic variables. The study also found significant regional factors in public debt, particularly for the euro area member states.

Saungweme (2019) used the Autoregressive Distributed Lag (ARDL) approach to examine the impact of public debt (domestic and international) on

economic growth in Zimbabwe for the period 1970 to 2017. The study complements the ongoing debate about public debt and economic growth by showing the impact of aggregate and shared public debt on economic growth.

Empirical results have shown that the impact of government debt on economic growth in Zimbabwe is negative, regardless of whether the government debt is aggregated or segregated and regardless of the type of debt - domestic or foreign. The results of the study also showed that domestic government debt is more catastrophic to the Zimbabwean economy than foreign ones. It was found that these results are applied regardless of whether the regression analysis is performed in the short or long term. The study recommends, among other things

Bittencourt (2019) stressed the importance of economic activity in reducing public debt ratios in the region. This shows that a 1% increase in GDP growth rate is associated with a 0.7% decrease in public debt. It also shows that inflation has negative signs in estimates using debt. From this study we also found that the coefficient for the remaining dependent variable is positive and significant, indicating that the debt to GDP ratio is a permanent variable.

Benfratello et al. (2018) Using data from a large group of countries in the period 1995–2015, the article empirically examines the effects of corruption on the national debt. Overall, estimates show that corruption increases the national debt. However, the effect seems to be heterogeneous in income-related model departments: it is stronger for advanced economies but weaker and less statistically robust for less developed countries, where external factors such as foreign aid can also influence national debt. The analysis points to the

inadequacy of common wisdom provided that more damaging tax effects of corruption occur in low-income countries.

A critical analysis of all the above empirical literature on the public debt seeks to only highlight the statistical relationship between public debt and macroeconomic factors. None of the studies attempted to indicate a threshold beyond which public debt can be reduced. This study extends the literature by determining how the efficiency of public spending is critical in reducing public debt. Its attempts to also determine the public spending threshold beyond which public debt can be reduced for policy purposes.

Government Spending and Income Inequality

There is substantial evidence that at least certain forms of government expenditure have tended to reduce income disparity in several nations and areas (e.g. Lustig et al., 2013). However, it is also acknowledged that the link between government expenditure and inequality is complicated, and numerous questions have been raised concerning the efficacy of government spending as a redistributive policy instrument, especially in low-income countries (LICs) and middle-income countries (MICs).

It is generally asserted, for instance, that government expenditure on social transfers tends to reduce income inequality, although the magnitude of the effect might vary considerably depending on the degree to which payments are targeted at lower income groups. If the majority of transfer spending is absorbed by the middle class for political economics reasons, the effect on inequality may be fairly little (Milanovic & Ersado, 2012). The same holds true for expenditure on indirect subsidies, which constitutes a large amount of

overall government spending in many developing nations, but which frequently favors higher income groups disproportionately (Nuru & Zeratsion, 2021).

Furthermore, it has been suggested that government expenditure on health and education decreases economic inequality by promoting a more equitable allocation of human capital. Nonetheless, the magnitude of the effect relies on how carefully such expenditures are targeted. There is evidence that urban middle-income groups receive the majority of the advantages of government health and education investment in developing nations (Anderson et al., 2017). The distinction between 'first-round' and'second-round' impacts is a crucial aspect of measuring the effects of government expenditure on income disparity (Clifton et al., 2017).

Since transfers are included in the definition of disposable income, the immediate first-round effect of government transfers to low-income families will be to reduce inequality in household disposable (post-fiscal) income. Nonetheless, over time, transfers can also have second-round impacts on inequality in household market (pre-fiscal) income, which can either strengthen or counteract the first-round effects. Government consumer expenditure, which does not include transfers or indirect subsidies, can nonetheless have considerable second-round impacts, but spending on elementary education, for instance, may increase income disparity only after a somewhat lengthy lag. (Lee et al., 2013).Therefore, the total consequences of government expenditure may vary depending on the method used to calculate income (post-fiscal or pre-fiscal) and the time period under consideration.

In addition, both expenditure and financing of spending can have an impact on income disparity, and the two impacts can either reinforce or cancel

each other out. It is sometimes suggested that the redistributive effect of taxation in developing nations has been restricted, as a result of factors such as an increased dependence on indirect taxes and widespread evasion of direct taxes (Mahon, 2018; Tanzi et al., 1981).There is evidence, however, that greater inflation increases income inequality (Siami-Namini & Hudson, 2019), which would negate the redistributive effect of government expenditure if it is supported by monetary expansion.

Consequently, from an empirical standpoint, the estimated impacts of government spending may vary depending on whether we are talking to the 'total' effect of expenditure, which includes its financing, or the 'pure' effect, which controls for its financing. Reverse causality is another key topic. It has been suggested that nations with greater market income disparity engage in more redistributive action (Goñi et al., 2011; Immervoll & Richardson, 2011).When market earnings are uneven, governments confront political pressure to redistribute income, according to this theory. In a democratic society, for instance, a greater proportion of the population will benefit from income taxes and transfers, and a parliamentary majority favoring redistribution will form.

Even in non-democratic systems, comparable mechanisms may work, for instance, through huge public protest in favour of redistributive political movements. Thus, the direction of causation between government expenditure and income disparity can flow in either direction, which, if not accounted for, might lead to misleading estimates of the causal influence of government spending on income inequality. Despite significant interest in the impact of

government expenditure on income inequality, the results of the econometric literature thus far look inconclusive.

A widely cited study (Dollar & Kraay, 2002) employing a large cross-country dataset found no evidence of a statistically significant relationship between government spending on health and education and the share of national income earned by the poorest 20 percent of households, a common measure of income inequality. The authors of a recent update to this study, Chu and Hoang (2020) discovered comparable results.Nonetheless, some recent research have revealed evidence that government expenditure on social welfare, education, and health has a negative and statistically significant impact on income disparity (Sacchi & Salotti, 2016; Selem-Amachree & Ezekwe, 2021).

There appears to be a role for meta-regression analysis in reconciling these seemingly contradictory econometric research findings and explaining why estimates of the influence of government expenditure on income inequality tend to fluctuate.We are aware of just one systematic evaluation of the evidence regarding the causes of income disparity. This is the research by Heimberger (2020), which examines the findings of 64 econometric studies examining the influence of education on income inequality. Their study revealed that indices of education had a negative influence on income inequality on average, and that the variation of results may be explained by a combination of changes in econometric specification and differences in measures of inequality and education.

Chapter Summary

Efficiency of public spending has become a topical issue in recent economic literature due to its importance in enhancing economic stability. This

chapter presented both the theoretical and empirical literature on efficiency of public spending, public debt, and income inequality. The chapter presented economic efficiency, technical and allocative efficiency, and the various measurement of efficiency in the literature. The chapter reviewed the views on Keynesian, classical, and the neo-classical schools of taught on public debt. The Keynesians' view on the role of public spending was also reviewed. The empirical review was done under the following headings (a) efficiency of public spending (b) efficiency of public spending and public debt (c) other determinants of public debt and (d) public spending and income inequality.

CHAPTER FOUR

RESEARCH METHODS

Introduction

This chapter introduces the methods used in the study. The next section presents an overview of the research paradigm followed by reasons justifying the adoption of quantitative approach to the study. The subsequent sections submit a description of the data sources employed for the study, hypotheses tested, models specified, and the estimation techniques employed for the study. The limitation of the research method as well as the chapter summary is also presented.

Research Design

Based on the objectives of this study, the study adopted the positivist philosophy that lies within Keynesian economics. The positivist philosophy assumes that reality is stable and can be observed and described from an objective point of view (Levin, 2008). For positivists, reality can be described from an objective point of view without affecting the phenomena studied (Shah et al., 2019). Positivist philosophy argues that phenomena should be isolated and observations repeated. This often involves manipulating reality with variations of only one independent variable to identify patterns and relate some of the constituent parts of the social world. Positivist philosophy lends itself to developing mathematical models to study the relationship between quantitative measurements.

Based on the positivist philosophy, this study used the quantitative method. The quantitative approach allows the researcher to incorporate the social and economic world into the structure of causality and negate the role of the human effect by using a quantitative tool such as multivariate statistical

analysis in analyzing the data used in this study. Since the aim of the study is explanatory, the study adopted the explanatory research as part of a quantitative approach. The explanatory design enables the researcher to identify the extent and nature of the cause and effect relationships. Explanatory research design is mainly used to study the effects of specific changes on existing processes. Based on the overall goal of the study, explanatory research design provides the best approach to research.

Efficiency of Public Spending on Human Capital

This section presents the models used to achieve the first empirical objective of the study. The first empirical objective of the study is to assess efficiency of public spending on human capital in Africa. Specifically, it (a) estimates technical efficiency scores for public spending on health (b) estimates technical efficiency scores for public spending on education (c) examines the correlates of efficiency of public spending on health and (d) examines the correlates of efficiency of public spending on education in Africa. The study used the Data Envelopment Analysis (DEA) to determine the technical efficiency scores while the Simar and wilson DEA Bootstrapping method was employed to determine the correlates of the Technical efficiency scores.

Data Envelopment Analysis (DEA)

A measure of the efficiency of public spending requires an assessment of the relationship between input and output costs. In order to empirically estimate the technical efficiency scores, this study used nonparametric Data Envelopment Analysis (DEA) to measure the technical efficiency values for decision making units (DMUs) with similar inputs and outputs. The advantage of using DEA is that inefficiency results can be evaluated without specifying a

threshold function that is normally unknown. The DEA approach can also be used with multiple inputs and multiple outputs. This technique helps evaluate and compare how efficient DMUs use available resources to generate a range of results. DMUs can include corporations, colleges, industry, banks, schools, banks, hospitals, government agencies, tax authorities, and prisons, among others.

Following the study by Ouertani et al. (2018) This study used the "Africa countries" as the DMUs. Farrell (1957) first introduced the approach and was later formalized by (Charnes et al., 1978), known as the CCR model, now known as the Constant Return to Scale (CRS). This has been demonstrated by Banker et al. (1984) to include Variable Returns to Scale (VRS). This study used the variable returns to scale DEA approach since it is an improvement on the CRS. There are two orientations in the DEA model: input-oriented and output-oriented DEA. With input-oriented, the linear programme ming model is formed to determine how much input DMU usage can be contracted when used efficiently to achieve the same output level while the output oriented determines the potential output DMU in relation to its inputs when effectively acting as a DMU on the verge of best practice frontier.

This study took an input-oriented approach as government is seen to have more control over inputs (public spending) than the outcomes. The approach is based on the convexity of the production frontier. The estimated frontier thus "envelopes" all available observations, and any deviation from this frontier is interpreted as an inefficient combination of inputs and / or outputs. Following Afonso and Kazemi (2017) and Ouertani et al., (2018) the study assumes there are *I* decision making units (DMU), each uses k inputs to produce

M outputs. If X is the k × I input matrix and Y is the M × I output matrix for all the I DMUs, then x_i is an input column vector and y_i is an output column vector for the i- th DMU. So for a given DMU the DEA model is as follow:

$$\min_{\emptyset, \delta} \emptyset$$

Subject to $-y_i + Y\delta \geq 0$ .....(23)

$$\emptyset x_i - X\delta \geq 0$$

$$I1'\delta = 1$$

$$\delta \geq 0$$

Where $\emptyset$ is a scalar that satisfies $0 \leq \emptyset \leq 1$ it measures the distance between a country and the efficiency frontier, defined as a linear combination of the best practice observations. If $\emptyset < 1$ it denotes inefficiency and the year (DMU) is inside the frontier while a $\emptyset = 1$ shows efficiency and it means the year (DMU) is on the frontier. The vector δ measures the weights employed to compute the location of an inefficient DMU if it were to become efficient, hence, maximizes productivity. The inefficient DMU can theoretically be on the production frontier as a linear combination of those weights, related to the peers of the inefficient DMU. The peers are other DMUs that are more efficient, and used as references for the inefficient DMU. The constraint $I1'\delta = 1$ is the convexity restriction imposed on the variable returns to scale DEA model.

Input and Output Variable Selection

The selection of input and output variables is very important in the frontier approach as they influence decision making. One of the prerequisites for using DEA is that the selected input and output variables have an isotonic bond, which can be confirmed by correlation analysis (Popović et al., 2020). If the correlation between input and output variables is positive, it means that the

variables maintain an isotonic bond and that the DEA model can use them. Literature can also be followed to select input and output variables. This study followed the works of Herrera and Ouedraogo (2018) and Ouertani, Naifar and Haddad (2018) to select input and output variables.

Country comparisons also require a certain homogeneity of production technology for health and education across countries. There are two specific aspects where the assumption of homogeneity is important. First, the comparison assumes that there are a small number of production factors that are the same in all countries. Second, the comparison requires that the quality of the inputs be the same, with the efficiency estimates skewed in favor of countries where the quality is higher.

Factor heterogeneity is not a problem if it is evenly distributed across countries. It will be problematic if there are differences between countries in the average quality of the factors (Farrell, 1957). The study will not tolerate this restriction as all countries are located on African continent and it is assumed that majority of both production technologies are used equally in all countries.

According to studies by Gupta and Verhoeven (2001), Herrera and Ouedraogo (2018) and Ouertani, Naifar and Haddad (2018), public spending on education (PSE) and public spending on health (PSH) were used as the input variable while life expectancy (Life_Exp), maternal mortality rate (MMR) and infant mortality ratio (IMR) were used as output variables for the health sector and gross enrollment in primary school (GPSER), gross enrollment in secondary schools (GSSER) as output variables for the education sector. The choice of these variables are of the fact that public spending on health and education has a significant effect on both health and education outcomes (Bein et.al, 2017).

Table 2: Input and Output Variables

Variable	Description	Source
PSH	Government Spending on Health	WDI
PSE	Government Spending on Education	WDI
Life_Exp	Life expectancy at birth, total (years)	WDI
IMR	Mortality rate, infant (per 1,000 live births)	WDI
MMR	Maternal mortality ratio (modeled estimate, per 100,000 live births)	WDI
GPSER	School enrollment, primary (% gross)	WDI
GSSER	School enrollment, secondary (% gross)	WDI

Source: Sikayena (2022).

Simar and Wilson DEA Bootstrapping Method

Fonchamnyo and Sama, (2016) used the OLS technique to determine the correlates of technical efficiency, the Tobit estimation technique (Afonso 2010; Dobdinga et al. 2016) or the fractional logit estimation by (Papke & Wooldridge, 1996). However, Simar and Wilson (2007) found that the efficiency values of the DEA are skewed upwards and serially correlated, since the estimate of the technical efficiency value for a given year t (or for each DMU) must include all other years (all other DMUs). In addition, the study expects a correlation between inputs and outputs and non-discretionary variables that could explain the efficiency since DEA estimates were computed from common samples. This leads to a violation of the independence assumption between the noise term ε_i and z_i. These shortcomings led Simar and Wilson (2007) to propose the two-step method for explaining efficiency.

Simar and Wilson (2007) proposed a double bootstrap method in order to obtain consistent conclusions about the efficiency values, the confidence intervals and to adequately estimate the parameters of the model. This study describes in details the "algorithm 1" procedure as suggested by Simar and Wilson (2007) and adopts it to determine the explanatory variables that influences efficiency.

1. Compute $\hat{\theta}_i$ for all DMUs I = 1,…,N using DEA
2. Use those K (with $K < N$) DMUs for which $\hat{\theta}_i > 1$ holds in a truncated regression (left truncated at 1) of $\hat{\theta}_i$ on z_i to obtain coefficient estimates $\hat{\alpha}$ and an estimates for variance parameter $\hat{\hat{\beta}}$ by maximum likelihood.
3. Loop over the following steps I to III B times to obtain a set of B bootstrap estimates $(\hat{\alpha}^b, \hat{\beta}^b)$, with b=1,…,B.
   I. For each DMU $i = 1, \dots, K$, draw an artificial error $\tilde{\varepsilon}_i$ from the truncated $N(0, \hat{\hat{\beta}})$ distribution with left truncated at $1 - z_i\hat{\beta}$.
   II. Calculate artificial efficiency scores $\hat{\theta}_i$ as $z_{i\hat{\beta}} + \tilde{\varepsilon}_i$ for each DMU $i = 1, \dots, K$.
   III. Run a truncated regression (left truncated at 1) of $\hat{\theta}_i$ on z_i to obtain maximum-likelihood bootstrap estimates $\hat{\alpha}^b \; and \; \hat{\beta}^b$
4. Calculate confidence intervals and standard errors for $\hat{\alpha}^b \; and \; \hat{\beta}^b$.

The study presented the Tobit regression model alongside the Simarwilson DEA bootstrapping model for robustness check.

Empirical Model Specification

In the empirical literature, many techniques can be considered to include these variables and accordingly to explain the different efficiency levels obtained. Following the works of Afonso et al. (2010), Fonchamnyo and Sama (2016), Gupta and Verhoeven (2001) among others the study selected the

explanatory variables for efficiency of public spending on human capital. To determine the empirical model that explains the correlates of efficiency of public spending on human capital (Health and Education), the study stated equations (30).

$$Efficiency_{it} = \beta_1 + \beta_2 Urban_{it} + \beta_3 Growth_{it} + \beta_4 GrowthSQ_{it} + \beta_5 Govt\_Exp_{it} + \beta_6 Inflation_{it} + \beta_7 FDI_{it} + \beta_8 Openness_{it} + \beta_9 Inst\_Qty_{it} + \beta_{10} Inst\_QtySQ_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots(30)$$

Definition and Justification of Variables

This section presents the variables used to determine the correlates of efficiency of public spending in both Health and Education. It presents how the variables were measured, justifies and also determines the a'prior sign of the independent variables in relation to the dependent variable (Efficiency of public spending on human capital).

Efficiency of public spending on human capital (Efficiency). In equation (30), efficiency of public spending on human capital is the dependent variable. It includes public spending efficiency on health and public spending efficiency on education. This variable ranges from zero (0) depicting least efficiency to one (1) depiciting most efficiency. It shows that amount of output that is needed to be achieved for a given input. Even though efficiency is a microeconomics concept, in this study, efficiency is a macro variable because the varibales used to estimate efficiency are all macro variables. This makes it easier to link efficiency variable to other macro varibles in this study.

Urbanisation (Urban) refers to urban population which indicates people living in urban areas as defined by national statistical offices. It indicates that the clustering of agents makes it cheaper to provide services in urban areas than

rural areas. The study expects either a positive or negative relationship between urbanisation and public spending efficiency on human capital. This is because clustering of agents makes it cheaper to provide services in an urbanised area (Herrera Aguilera & Ouedraogo, 2018). A study conducted by Jetter and Parmeter (2013) showed a strong positive effect of urbanisation on efficiency, with the number of urban citizens increasing by 1 percent, leading to a 0.2 percent increase in public spending efficiency. The results suggested that the public sector could become more important around the world as urbanisation progresses. At the same time urbanisation is usually associated with pollution and the government may have to spend more on health and sensitisation (education).

Economic Growth (Growth) shows the annual percentage growth rate of GDP per capita based on constant local currency. GDP per capita is gross domestic product divided by midyear population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. This variable captures the level of development. It can be used as an environmental variable to explain efficiency. The study expect growth to have a positive association with public spending efficiency. Growth can contribute to a formalized and effective institutions which ensures that public resources are efficiently used. Sun et al. (2017) found a positive correlation between efficiency constraints and per capita GDP above a certain threshold.

The study included the squared term of the growth variable (GrowthSQ) to determine how public spending efficiency on human capital changes throughout a country's stages of growth and development. The long run effect of economic growth and development is expected to enhance public spending efficiency since that could have been achieved due to improved technology and quality institutional framework and policies. The study expects a positive relationship between the squared term of growth and public spending efficiency.

Government Expenditure (GovtExp)

Government expenditure was used to proxy for the size of the public sector in this study. The size of the public sector also plays a role in the efficiency of government spending. Past studies that investigated the relationship between the size of the government (or expenditure as a percentage of GDP) and efficiency levels verified whether additional pubic spending is associated with better education and health outcomes.

This study expects a negative correlation between government expenditure and public spending efficiency depending on the size of the expenditure. Studies such as Gupta and Verhoeven (2001) identified a negative coefficient. Afonso et al. (2020) explained that the smaller the size of government (government spending) the more efficient in public spending since smaller government size can easily be monitored to fight corruption.

Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. It is expected to have a negative impact on the efficiency of public spending. Inflation reduces the level of investment as well as causes inefficient

allocation of resources employed. Fischer et al. (1981) explained that "inflation is associated with relative price variability that is unrelated to relative scarcities and hence leads to misallocation of resources". Inflation is said to reduce the competitive edge of most efficient firms since their product becomes relatively expensive as compared to imports from a low inflation countries, thereby reducing the demand for these product and this can lead to an eventual collapse of these firms. A study conducted by Dobding et al. (2016) confirmed a negative relationship between inflation and public spending efficiency.

Foreign Direct Investment (FDI) reflects the net inflows of investment to acquire a lasting management interest 10 percent or more of voting stock in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This study expect a positive relationship between FDI and efficiency of public spending. This is because FDI enhances the capacity of productive units through increase in resources or technology. According to Zhang et al. (2019) foreign direct investment correlates positively with the efficiency of government environmental spending in terms of quantity and quality of consumption and has a positive effect.

Trade openness (Openness) (exports and imports as a share of GDP). This indicator proxies the degree of international competition over labour and capital that would penalize public inefficiency disproportionately. The study expects a positive relationship between trade openness and efficiency of public spending. Competition from international trade compels local producers and the government to produce efficiently to remain competitive.

Institutional Quality (Inst_Qty). The study estimated the the mean value of the six governance indicators (Control of corruption, voice and accountability, political stability, governance effectiveness, regulatory quality and rule of law) as an index to control for institutional quality. This variable measures the extent to which a country's policy and institutional frameworks are able to prevent and fight against wastage and ensure efficient allocation of resources. Higher Percentile rank of this variable indicates effective and efficient institution and vice versa. Countries with effective and efficient institutions, more transparency, and less corruption are able to avoid wastage and are more efficient in resource allocation than countries with weak institutions. Effective institutional policies and framework are associated with higher efficiency of public spending (Grigoli & Ley, 2012). This study expect a positive relationship between control of corruption and efficiency of public spending on human capital (health and education)

The study included the squared term of institutional quality (Inst_QtySQ) to indicate how public spending efficiency changes with time with better institutional policies and frameworks. The study expects a positive relationship between institutional quality and public spending efficiency. This is because as institutions grow and become better, it should have the ability to fight against social vices such as corruption which diverts public spending from social priorities, mismanagement of resources, depletion of nation's wealth and transfers state resources into private gains at the expense of the collective masses (Malyniak et al., 2019).

Table 3: Summary of Variable Definition, Expected Sign and Data Source

Variable	Definition	Expected Sign	Source
Efficiency	Public spending efficiency on human capital (health and education)	Dependent variable	Estimated
Inst_Qty	Institutional Quality	+	Estimated
Inst_QtySQ	Squared term of Institutional Quality	+	Estimated
Urbanization	Urban population (% of total population)	+/-	WDI
Growth	GDP per capita growth (annual %)	+	WDI
GrowthSQ	Squared term of growth variable	+	Estimated
GovtExp	General government final consumption expenditure (% of GDP)	-	WDI
Inflation	Inflation, consumer prices (annual %)	-	WDI
FDI	Foreign direct investment, net inflows (% of GDP)	+	WDI
Openness	Addition of export and import of goods and services (% of GDP)	+	Estimated

Source: Sikayena (2022).

Efficiency of Public Spending on Human Capital and Public Debt

This section presents models employed to achieve the second empirical objective of the study. The second empirical objective seeks to investigate the relationship between efficiency of public spending on human capital and public debt in Africa. Specifically, the study (a) examined the effect of efficiency of public spending on health on public debt (b) examined the effect of efficiency of public spending on education on public debt. It also seeks to determine the minimum efficiency level required, beyond which efficiency in public spending on health and education can improve public debt. The study employed the system dynamic panel regression technique to investigate the relationship

between efficiency of public spending on health and education on public debt. Lind and Mehlum test for U-shaped or inverted U-shaped relationship was conducted to determine the threshold level of efficiency of public spending on human capital that can improve public debt in Africa.

Theoretical Model Specification

The relationship between efficiency of public spending and public debt dynamics can be analyzed from the debt sustainability perspective expressed in macroeconomic literature and the approach used by IMF (Debrun et al., 2019). Algebraically, the debt level of a nation, at any given period, can be expressed as:

$$PD_t = (1 + r_t)PD_{t-1} - PB_t \quad \text{.....(31)}$$

But $PB_t = T_t - PS_t$ .....(32)

Where PD_t indicates public debt level at time t, r_t denotes interest rate on debt, PD_{t-1} is the previous level of public debt, PB_t is the primary balance. Primary balance is the difference between public spending PS_t and total government revenue T_t for current year. Equation (31) can be expressed in terms of nominal GDP ratios to derive equation (33)

$$\frac{PD_t}{Y_t} = (1 + r_t)\frac{PD_{t-1}}{Y_{t-1}} - \frac{PB_t}{Y_t} \quad \text{.....(33)}$$

If $Y_t = Y_{t-1}(1 + \delta_t)$ .....(34)

Then equations (33) can be rewritten as

$$D_t = \left(\frac{1+r_t}{1+\delta_t}\right) D_{t-1} - PB_t \quad \text{.....(35)}$$

From equation (35) D_t is public debt to GDP ratio at time t, r_t and δ_t denotes interest rate and GDP growth rate respectively. It is important to note that public debt is not only denominated in local currency. In developing

countries such as Africa, a substantial portion of public debt is denominated in foreign currency. Adding external debt aspect in equation (35) gives;

$$D_t = \left(\frac{1+1}{1+\delta_t}\right) D_{t-1} - PB_t + \left(\frac{1+i^f}{1+\delta_t}\right) EX_1 \varphi_{t-1} D_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots(36)$$

Where i^f denotes interest rate on foreign currency denominated debt, EX is the exchange rate depreciation and φ_t is the share of total debt denominated in foreign currency. From equation (36), it shows that the higher the interest rate, exchange rate , previous debt and interest rate denominated in foreign currency, the higher the debt to GDP ratio. However, according to this equation, debt is negatively associated with primary balance and economic growth rate. Therefore, the government can negotiate lower interest rate debts, change the currency composition of debt, or try stabilizing the exchange rate, for instance, through attracting more foreign direct investments or increasing exports. Alternatively, to reduce the accumulated debt burden, governments either should run a surplus budget or strive to achieve higher economic growth.

Empirical Model Specification

In reality there are a multiplicity of factors that influences the public debt of a country. The study goes a step further to carry out a multivariate analysis when these variables are allowed to interplay. These variables were placed in a model to explain their relationship with public debt. The reduced form of the model is given as follows;

$$PD_{it} = \alpha_i + x_{it}'\beta + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(37)$$

where $i = 1,2,3, \ldots 14,15,16$ and $t = 1,2,3, \ldots 10,11,12$, α_i denote the intercept while x_{it} is a vector of explanatory variables in country i at time t. Following the works of Abdul Razak (2018); Briceño and Perote (2020); Gargouri and

Keantini (2016); Omrane Belguith and Omrane (2017), these variables are public Spending, Broad Money Supply (BMS) Foreign Direct Investment (FDI) external Aid (Ext_Aid), Openness, population growth rate, Urban and Corruption. β is the constant term while ε_{it} represents the random error term that is assumed to be normally distributed.

Estimation Technique

The study used the system GMM for its estimations. A panel model contains two subscript (i and t) which differentiate it from either cross-sectional (i) or time series (t). Thus a panel data can be seen as a time series of individual cross-sections and hence has the attributes of both time series and cross-sectional data. Panel data therefore has some superiority over pure cross sectional or time series data especially its ability to handle individual heterogeneity (Greene & Hensher, 2003). The estimation technique employed must therefore be able to handle both attribute to ensure efficient and consistent estimates. There are several specifications of a panel model but the type specified in equation (37) assume an individual varying effect which is constant over time. This specification allows the variations in the dependent variable to be attributed to the explanatory variables after controlling for individual effects (Greene & Hensher, 2003).

The estimation of the dynamic model cannot be done the usual way of estimating static panel models because of the inclusion of the lag dependent variable as an explanatory variable. That is, the introduction of the lag-dependent variable as an explanatory variable has the tendency of creating endogeneity in the model. To avoid the tendency of biasedness due to the problem of endogeneity an alternative estimator may be necessary to estimating

the model in Equations (37). The available options are the GMM instrumental variable (IV) estimator and direct bias corrected estimators (Behr, 2003). In the case of endogenous predetermined regressors, the system-estimator proposed by Blundell and Bond (1998) is unbiased and most efficient, while the direct biased corrected estimators perform similar to the GMM-estimator proposed by Arellano and Bond in 1991 (Behr, 2003). The concept of instrumental variable estimations requires identifying an instrument that will be able to mitigate the problem of endogeneity in the model.

An instrument is a variable that satisfies both the validity and relevance assumptions. The major drawback in the basic instrumental variable model `has to do with the ease with which a valid and relevant instrument can be located and used (Wooldridge, 2002). To minimize the task of searching for an appropriate instrument, several authors have developed a variant of the IV estimator that uses the lags of the variables in the models (Blundell & Bond, 1998). According to Arellano-Bond (1991) as many as instruments can be generated from a panel data, where N is the number of individual observation and T is the maximum time period. According to Roodman (2020), the Arellano and Bond (1991) difference GMM estimator was first proposed by Holtz-Eakin et al. (1988) and later expanded by Arellano and Bond in 1991.

Like in the case of other difference GMM estimators, the Arellano and Bond estimator perform poorly as the exogenous regressors in the model increases. That is, the Arellano and Bond estimator can perform poorly if the autoregressive parameters are too large or the ratio of the variance of the panel-level effect to the variance of idiosyncratic error is too large (STATA Inc., 2009). An improved version of the Arellano and Bond panel data difference

GMM estimator was outlined by Arellano and Bover (1995) and fully developed by Blundell and Bond (1998). Arellano and Bover (1995) construct a panel data GMM estimator in which the regression equations are in levels, and the additional instruments are expressed in lagged differences. Blundell and Bond (1998) augment the original differences GMM estimator with the level-equation estimator to form a system of equations known as "system GMM".

The resulting system of regression equations in differences and also levels has better asymptotic and finite sample properties than the Arellano-Bond (1991) differences GMM estimator (Blundell & Bond, 1998). The Blundell and Bond (1998) estimator accommodates exogenous variables by including instrument generated from the exogenous variables. The System-GMM estimator (Blundell-Bond estimator) uses both lagged levels as instruments for contemporaneous first-differences and lagged differences as instruments for contemporaneous levels, whereas the Difference-GMM (Arellano-Bond estimator) estimator uses only lagged levels as instruments for contemporaneous differences. The study therefore settled on the Blundell and Bond (1998) system GMM approach to estimate the dynamic model. The approach is integrated into the STATA version 14 which was used in this study.

Empirical Model Specification

The empirical model that sets the relationship between efficiency of public spending on human capital (Health and Education) with public debt together with the other control variables was stated as follows;

$$PD_{it} = \alpha_i + \delta_1 PD_{it-1} + \delta_2 PSH_{it} + \delta_3 H\_VRSTE_{it} +$$

$$\delta_4 H\_VRSTE\_SQ_{it} + \delta_5 BMS_{it} + \delta_6 Growth_{it} + \delta_7 FDI_{it} + \delta_8 ExtAid_{it} +$$

$\delta_9 Openness_{it} + \delta_{10}\text{Inflation} + \delta_{11} Pop_{Growth_{it}} + \delta_{12} Urban_{it} +$

$\delta_{13} Corruption_{it} + \varepsilon_{it}$ ……..(38)

$PD_{it} = \alpha_i + \delta_1 PD_{it-1} + \delta_2 PSE_{it} + \delta_3 E\_VRSTE_{it} + \delta_4 E\_VRSTE\_SQ_{it} +$

$\delta_5 BMS_{it} + \delta_6 Growth_{it} + \delta_7 FDI_{it} + \delta_8 ExtAid_{it} + \delta_9 Openness_{it} +$

$\delta_{10}\text{Inflation} + \delta_{11} Pop_{Growth_{it}} + \delta_{12} Urban_{it} + \delta_{13} Corruption_{it} +$

ε_{it} ……..(39)

Definition and Justification of Variables

This section presents the variables used to determine the relationship between efficiency of public spending on human capital (Health and Education) and public debt. The section presents how the variables were measured, justifies and also determines their expected signs in relation to the dependent variable (Public Debt).

Public Debt (PD): in this study, external debt stock to gross national income was used as proxy for public debt due to data availability and its proportion in total debt. Public debt is the dependent variable in this model. Total external debt is debt owed to non-residents repayable in currency, goods, or services. Total external debt is the sum of public, publicly guaranteed, and private nonguaranteed long-term debt, use of IMF credit, and short-term debt. Short-term debt includes all debt having an original maturity of one year or less and interest in arrears on long-term debt. GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.

Lagged Public Debt. The lag of public debt shows how previous accumulated debt influences current debt. Previous debt has the tendencies to

increase current debt hence a positive relationship is expected. At the same time previous debt accumulated at a high level can be an incentive for government to ensure fiscal discipline which can also reduce the debt level. Developing countries that are heavily burdened with debt can sometimes benefit from debt reliefs programme mes such as the HIPC initiative by the World Bank and IMF to reduce the burden of concessional loans accumulated over the years hence a negative association is also expected.

Public spending on human Capital (Health and Education). The study looked at public spending on health (PSH) as percentage of GDP and public spending on education (PSE) as percentage of GDP. A reduction in public spending would, at least in theory, lead to an improvement in sustainable debt. Huge spending cuts and higher tax revenues can have a significant impact on national production and thus on price levels. Notwithstanding these possibilities, fiscal discipline in terms of reducing public spending and increasing tax collection efforts is a sure way to achieve sustainable public debt. As a result, this study expects a positive relationship between public spending on human capital (health and education) and public debt. Studies as such Makin and Ratnasiri (2015) as well as Mehmood et al. (2014) have all confirmed a positive relationship between public spending and public debt.

Efficiency of public spending on Human Capital. This include efficiency of public spending on health and efficiency of public spending on education. This variable ranges from zero (0) being the least efficient to one (1) being the most efficient. In this study, efficiency of public spending was estimated as depicted in equation (23). Efficiency of public spending is theoretically expected to improve public debt and make it sustainable, thus a negative

coefficient is expected in this study. This is because efficiency is expected to reduce wastage which leads to a decrease in government spending hence a reduction in debt. A reduction in the efficiency in public investment decreases economic growth and increases debt. Angelopoulos et al. (2008) confirms a negative relationship between efficiency and public debt.

The study showed that at low efficiency, a growing public sector reduces growth and that an efficient public authorities are more successful in setting up and implementing consolidated programme s. There are two elements in this hypothesis. A first one is that the same consolidation programme will be more effective in bringing down the public debt ratio when it is adopted by a more efficient government apparatus. Private agents may then see the programme as more credible, and believe it to be more durable. A second element is that more efficient governments adopt better consolidation programme s when it comes to size and composition.

Squared of efficiency of public spending on human capital: this study included the squared term of efficiency of public spending on health and education to indicate the non-linear relationship between efficiency of public spending on human capital and public debt. The study expects an inverted U-shape. This is because efficiency at its highest level reduces waste which leads to spending cut, hence an improvement in debt. This study expect a negative coefficient since efficiency in public spending is expected to improve public debt in the long run.

Broad Money Supply (BMS): Broad money is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the

central government; bank and traveler's checks; and other securities such as certificates of deposit and commercial paper. This study expect a positive relationship between money supply and public debt. All other things being equal, the larger the money supply, the lower the market interest rate, making it less expensive to borrow. Also a least credible monetary policy in theory is expected to result in high interest rate which influence borrowing.

Growth measures the annual percentage growth rate of GDP per capita based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. This study expects a negative coefficient on the relationship between growth and public debt. Higher growth increases the economy's capacity to sustain debt. Also, when debt is measured as a share of GDP, increase in growth lowers the debt to GDP ratio. Studies such as Abdul Razak (2018), Gargouri and Keantini (2016) and Ksantini (2016) have all identified a negative significant relationship between public debt and growth.

Foreign Direct Investment (FDI): Foreign direct investment is measured as the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. This study expects a negative relationship between FDI and public debt. It is argued that FDI inflows contribute towards increased employment, increase revenue in terms of taxes collected, technology spillover and innovation to the host country which have the tendencies to improve productivity and debt. Studies in the past have confirmed a negative relationship between FDI and public debt (Onafowora & Owoye, 2019; Ouhibi et al., 2017).

External Aid (Ext_Aid): Net official aid refers to aid flows (net of repayments) from official donors to countries and territories in part II of the DAC list of recipients: more advanced countries of Central and Eastern Europe, the countries of the former Soviet Union, and certain advanced developing countries and territories. External Aid is expected to have a negative relationship with public debt since aid in a form of cash or goods reduces government expenditure hence a reduction in budget deficit and debt. The Bulov-Rogoff model suggests how aid is used to finance debt (Bulow et al., 2020). In this model, the debtor country is considered a developing country because the developing countries discount rate is assumed to be above the world rate. This assumption also provides an explanation for the developing countries loan. The Bulov-Rogoff model shows that debt can be backed by aid if the debtor country can deduct sideways payments from the government of a developed country. Side payments are made to ensure that all debt rescheduling agreements are completed in a timely manner so that trading is not disrupted.

Openness: This is measured as the ratio of the sum of exports and imports of goods and services over GDP, as named, it measures the degree of openness of countries to international trade. Trade openness is another important factor that affect public debt. Depending on the level of imports and exports, openness can have a positive or negative effect on the debt burden. When exports are higher than imports, the openness of trade negatively affects debt, as higher levels of trade guarantee the availability of foreign exchange, which is vital to repaying the debt, while imports, if higher than the exports will positively affect debt. In countries where imports are growing faster than exports (such as countries where trade liberalization has taken place), a positive

sign effect is expected. Colombo and Longoni (2009) found that the effect of openness was positively related to external debt in a group of industrialized countries, while Bittencourt (2019) found, among other things, that the effect was negative. Trade openness promotes the country's growth prospects.

Inflation was also measured by the consumer price index which reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The relationship between inflation and public debt is theoretically negative. An increase in the general price level is likely to reduce the rate of growth in public debt. During periods of inflation, borrowers tend to win while creditors tend to lose. Rising prices will lead to an increase in productivity, which will lead to a lower proportion of external debt in production. Empirically, the connection between inflation and the sustainability of foreign debt is not a clear question.

The main question that quickly arises is whether there is an optimal inflation rate that is compatible with sustainable external and internal borrowing (Anand & van Wijnbergen, 1988). Aizenman and Marion (2011) found that there is a trade-off between inflation targets and public debt sustainability that confirms the theoretical relationship. This discovery was previously substantiated by (Burdekin & Vohar, 1990). Other studies such as Afonso and Jalles (2019), Cherif and Hasanov (2018), Hilscher et al. (2020) all identified inflation to decrease public debt. This study however expect inflation to have a negative relationship with public debt.

Population Growth (Pop_Growth). This shows the annual growth rate of population. The study expects population growth rate to have a positive

relationship with public debt. This is because increase in population growth requires more infrastructure development such as expansion in health and educational facilities which leads to increase in public spending. Increase in public spending demand more resources to meet the expenditure need hence the increase in public debt if increasing spending is financed by borrowing.

Urbanisation (Urban): This refers to people living in urban areas as defined by national statistical offices. It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanisation Prospects. Urbanisation is expected to have a positive relationship with public debt. Urbanisation increases public spending (Jetter & Parmeter, 2013). This has the propensity to increase budget deficit, hence an increase in public debt if budget deficit is financed by borrowing. Other studies have confirmed a positive relationship between urbanisation and debt (Nugraha & Handra, 2021)

Control of Corruption (Corruption): This captures the 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. Percentile rank indicates the country's rank among all countries covered by the aggregate indicator, with 0 corresponding to lowest rank, and 100 to highest rank. Regarding the relationship between control of corruption and public debt, the study expects a negative relationship. Control of corruption achieved through institutional quality ensures fiscal discipline, developmental funds that otherwise could have been diverted for private gains can be controlled and be used for developmental projects. Control of corruption prevents wastage, attracts foreign investment which can lead to increase in

economic growth. This can reduce borrowing since government will have enough funds through growth to spend.

Table 4: Summary of Variable Definition, Expected Sign and Data Source

Variable	Definition	Expected Sign	Source
Public Debt (PD)	External debt stocks (% of GNI)		WDI
Lagged (PD)	Previous debt accumulated	+/-	Estimated
PSH	Public Spending on Health	+	WDI
PSE	Public Spending on Education	+	WDI
H_VRSTE	Efficiency of public spending on Health	-	Estimated
E_VRSTE	Efficiency of public spending in Education	-	Estimated
H_VRSTE_SQ	Squared term of Efficiency of public spending on Health	-	Estimated
E_VRSTE_SQ	Squared term of Efficiency of public spending on Education	-	Estimated
Broad Money Supply (BMS)	Broad money (% of GDP)	+	WDI
Economic Growth (Growth)	GDP growth (annual %)	-	WDI
Foreign Direct Investment (FDI)	Foreign direct investment, net inflows (% of GDP)	-	WDI
External Aid (Ext_Aid)	Net official development assistance and official aid received (current US$)	-	WDI
Trade Openness	It determines the extent of trade liberalization in a country which is measured by the addition of export and import of goods and services	-/+	Estimated
Inflation	Inflation, consumer prices (annual %)	-	WDI
Population Growth	Population growth (annual %)	+	WDI
Urbanisation (Urban)	Urban population (% of total population)	+	WDI
Corruption	Control of Corruption: Percentile Rank	-	WGI

Source: Sikayena (2022)

Regression Diagnostics and Post Estimations Tests

The GMM based estimators do not impose a lot of assumptions on the error term. As such very few post estimation tests are needed after a GMM based estimation (Wooldridge, 2002). Two popular tests are proposed after the Arrelano and Blundell estimation (Blundell & Bond, 2000). The first is the Arrelano and Bond test of autocorrelation (*AR-TEST*) which is built in the STATA 14 package as *estatabond*.

The *AR-TEST* report the test statistics for the first and second difference autocorrelation in default mode but the lag levels can be adjusted. It has a null hypothesis of no autocorrelation in the first difference error. Thus, it is require that the null hypothesis is not rejected. That is, the bigger the probability value of the *AR-TEST* the lesser the problem of autocorrelation in the model.

A rectification to the autocorrelation problem is to estimate the two-step equation. In two-step estimation, the standard covariance matrix is robust to panel-specific autocorrelation and heteroskedasticity, but the standard errors are downward biased (Mileva, 2007). Two-step robust can be used in STATA to get the finite-sample corrected two-step covariance matrix (Drukker, 2010). The second test is the Sargan test or Hansen test of valid over-identifying restriction. It has a null hypothesis of correct over-identifying restrictions which requires that we fail to reject the null Just as in the case of the *AR-TEST*.

Lind and Mehlum test for U-shape or inverted U-shaped Approach

The study conducted a threshold analysis to identify the minimum efficiency level in public spending on human capital required to improve public debt. Because the system GMM provides only the necessary condition for the existence of a U-shaped or inverted U-shaped relationship but without the

sufficient condition, the study proceeds to conduct the Lind and Mehlum (2010) U-shaped test approach. Lind and Mehlum (2010) built on the work of Sasabuchi (1980) to develop a test that overcomes the problem of misinterpreting the actual non-linear relationship existing between two variables in conventional non-linear econometric models.

In these models, U-shaped or inverted U-shaped relationships are examined by looking at the different signs and the statistical significance of the original variable and its squared term. According to Lind and Mehlum (2010), this conventional method of testing for a non-linear relationship is inappropriate. Lind–Mehlum U-shaped approach ensures that the necessary and sufficient conditions for the existence of a U-shape are provided on some interval values where the relationship decreases at the left side of the interval and increases at the right. Following equations (38) and (39) the test can be conducted by following the condition as stated below

$$\delta_3 + \delta_4 H\_VRSTE_{min} < 0 < \delta_3 + \delta_4 H\_VRSTE_{max} \quad \text{.....(40)}$$

$$\delta_3 + \delta_4 E\_VRSTE_{min} < 0 < \delta_3 + \delta_4 E\_VRSTE_{max} \quad \text{.....(41)}$$

This condition examines whether public debt is rising at the left side of the interval values and declining at the right side of the interval values to ascertain the exact non-linear relationship (either U-shape or inverted U-shape) between efficiency of public spending on human capital (health and education) and public debt. Sohag et al. (2015) also employed the Lind and Mehlum (2010) U shaped test to confirm the existence of a U-shaped relationship between GDP growth and CO2 emissions in Malaysia.

Efficiency of Public Spending on Human Capital and Income Inequality

This section presents the models employed to achieve the third empirical objective of the study. The third empirical objective seeks to investigate the relationship between efficiency of public spending on human capital and Income Inequality in Africa. Specifically, it examines (a) the effect of efficiency of public spending on health on income inequality (b) the effect of efficiency of public spending on education on income inequality. The study employed system GMM to determine the relationship between efficiency of public spending on human capital and income inequality.

Empirical Model Specification

This section specified an econometric model that describes the relationship between efficiency of public spending on human capital and income inequality. Other control variables were also included to assess their effect on income inequality. In the third empirical chapter, the dependent variable which is income inequality is continuous in nature, hence ordinary least square (OLS) technique can be used for analysis. However, OLS cannot take care of the country fixed effect as well as a possibly endogeneity which is suspected between efficiency of public spending and income inequality, therefore a Panel Regression model must be resorted for analysis. It is interesting to note that, the fixed effect model which is a static panel though takes care of the country fixed effect also fails to solve endogeneity issues in the model hence literature suggest the use of an instrumental variable or GMM model. Due to the difficulty in identifying an appropriate instrument, this study used the GMM model which have the ability to solve the endogeneity issues as well as taking care of the country fixed effect.

The study employed the dynamic panel estimation to examine the relationship between efficiency of public spending on human capital and income inequality as suggested by Blundell & Bond (1998). The study used the GMM approach because it is able to obtain a consistent coefficient even in the presence of a measurement error and an endogenous right variable. Different assumptions about the existence of measurement errors and the endogeneity of the correct variables affect the validity of certain instruments. These assumptions can be tested within the GMM using Sargan test. The empirical model for the third empirical chapter is presented in equation (42)

$$Income\_Inq_{it} = \alpha_i + x_{it}'\beta + \varepsilon_{it} \quad \text{.....(42)}$$

where $i = 1,2,3, \ldots 14,15,16$ and $t = 1,2,3, \ldots 10,11,12$, α_i denote the intercept while x_{it} is a vector of explanatory variables in country i at time t. β is the constant term while ε_{it} represents the random error term that is assumed to be normally distributed and $Income\_Inq_{it}$ is income inequality in country i at time t which is the dependent variable.

Econometric Model Specification

The empirical model that sets the effect of efficiency of public spending on human capital (health and education) on income inequality together with the other control variables was stated in equations (43) and (44)

$$Income\_Inq_{it} = \alpha_i + \beta_1 Income\_Inq_{it-1} + \beta_2 PSH_{it} + \beta_3 H\_VRSTE_{it} + \beta_4 Inst\_Qty_{it} + \beta_5 Growth_{it} + \beta_6 FDI_{it} + \beta_7 Urban_{it} + \beta_8 Inflation_{it} + \beta_9 Openness_{it} + \varepsilon_{it} \quad \text{.....(43)}$$

$$Income\_Inq_{it} = \alpha_i + \beta_1 Income\_Inq_{it-1} + \beta_2 PSE_{it} + \beta_3 E\_VRSTE_{it} + \beta_4 E\_VRSTESQ_{it} + \beta_5 Inst\_Qty_{it} + \beta_6 Growth_{it} +$$

$\beta_7 FDI_{it} + \beta_8 Urban_{it} + \beta_9 Inflation_{it} + \beta_{10} Openness_{it} + \varepsilon_{it}$ ……..(44)

Definition and Justification of Variables

For empirical chapter three, the study used income inequality (Income_Inq) as its dependent variable which is measured using the Gini coefficient obtained from the Standardised World Income Inequality Database (SWIID). It is the estimate of Gini index of inequality in equalized (square root scale) household disposable (post-tax, post-transfer) income. The study focused mainly on the net Gini, which captures inequality in disposable income (post-tax and post-transfer). The Gini index ranges between 0 and 1, where 0 means perfectly egalitarian distribution and one (1) would denote perfect concentration.

Lagged of Income Inequality: The study expect previous income inequality to have either a positive or negative coefficient with current income inequality. This is because previous income inequality can worsen current income inequality if no intervention is put in place to control it. This can create vicious cycle since a more unequal society will continue to make the rich become richer and the poor becoming poorer if no policy intervention is put in place to bridge the income gap. However, income inequality in previous years can trigger strict policies such as increasing of minimum wage and other educational policy that can reduce income inequality in current years.

Public Spending on Education (PSE): This is measured as public education spending as percentage of GDP. This study expects public spending on education to improve income inequality. Higher public spending in education has long been promoted with the expectation that expanding access to education

enhances upward social mobility by making lower-income individuals more productive and better able to compete for higher-paying jobs associated with higher degrees (Becker 1964). Public intervention in the form of spending is particularly important when lower-income individuals lack adequate access to credit, which may undermine their ability to afford getting an education. An expansion of the number of graduates also reduces the skill gap and the associated wage gap, eventually making income distribution more equal (Kuznets, 1955). However, going as far back as Tanzi (1974), there has also been wide recognition that the difficulty of accurately targeting regular education spending to the poor has made this spending less effective in reducing inequality. In some cases, such spending could actually worsen inequality. Among other reasons, the benefits of government spending, including education programme s, are often captured by the urban middle class for political economy reasons, potentially worsening income inequality (Schwartz & Ter-Minassian, 2000).

Public Spending on Health (PSH): Similar to education spending, health spending can enhance productivity through higher human capital accumulation (Grossman, 2000). Public intervention in this sector is also important to reduce gaps in access, but similar targeting issues (as for education spending) may lead to a capture of the benefits of public health spending by the middle class, minimizing its impact on inequality or even worsening it (Schwartz and Ter-Minassian 2000).

Efficiency of public spending on human capital (Education and Health) are estimated to capture the effect of efficient public spending on income inequality. It ranges from 0 to 1 where 0 denote total inefficiency and 1 denote

complete efficiency in public spending. Efficiency of public spending on health and education is expected to have a negative significant coefficient. Efficiency in public spending on human capital leads to growth and development which can transcends to the micro level hence empowering individual to be more productive. Again a more efficient governments adopt better consolidation programme s that improves the wellbeing of individuals and society. Cyrek (2019) confirmed a negative association between economic efficiency and inequality.

The study also included the squared term of efficiency of public spending on education (E_VRSTESQ) to test for the composition effect and compression effect theory of education expansion by Knight and Sabot (1983). The composition effect arises from the fact that, a change in the proportion of labour force that is educated and its effect on income inequality is similar to the process proposed by Kuznets (1955). As the number of educated employee increases, it initially increases income inequality because the few privileged highly educated employees will comparatively earn higher wages, however, after a certain threshold, as the supply of skilled employee increases, the wage premium for highly skilled employee decreases, thus lowers income inequality which is the compression effect.

Institutional Quality (Inst_Qty): The study created an index for six institutional variables namely control of corruption, rule of law, political stability, voice and accountability, government effectiveness and regulatory quality to capture institutional quality. This variable measures the extent to which a country's policy and institutional frameworks are able to improve income inequality. Higher Percentile rank of this variable indicates effective

and efficient institution and vice versa. Institutional quality improves income inequality by ensuring economic growth and development, preventing biased tax systems favouring the wealthy and well connected, increases the level of effectiveness of social spending, and ensures equal access to education and public services. The study expects institutional quality to reduce income inequality.

Growth variable was added to capture the level of development and wellbeing of the people in a country. This variable is expected to have a negative coefficient with income inequality since economic growth is often positively associated with higher investments, higher employment-generating processes and higher employment, hence giving greater access to jobs and income to a larger number of people. Studies such as Kurniasih (2017) and Younsi and Bechtini (2020) have also confirmed a negative association between growth and income inequality.

Foreign Direct Investment (FDI): The relationship between FDI and income inequality is well debated in literature (Aigheyisi, 2020; Huang et al., 2020; Kaulihowa & Adjasi, 2018; Khan & Nawaz, 2019; Teixeira & Loureiro, 2019; Wang et al., 2020; Zhang et al., 2019). While FDI is noted of contributing to the growth and development of the host country through such channels as transfer of modern technology and management skills, human capital development and exporting market access, the theoretical and empirical predictions on the impact of FDI inflows on income inequality have become more inconclusive. While the first group reveals that increasing FDI inflows have contributed to greater income inequality due to the wage gaps between the foreign and domestic firms and increased wages of skilled employees in

corresponding sectors, the second group claims that FDI inflows have helped to reduce income inequality through the channels of improving the income of low skilled employees and reducing poverty from economic growth stimulated by foreign direct investment; and the third group indicates that no significant relationship exists between FDI inflows and income inequality. The study expect either a positive or negative significant relationship between FDI and income inequality.

Urbanisation captures the people living in urban areas as defined by national statistical offices. It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanisation Prospects. Urbanisation is expected to increase income inequality since wages are higher for urban jobs than rural jobs. The wage differences between urban dwellers as compared to their rural counterparts is huge due to the educational differences and the kind of jobs available in these areas.

Inflation was measured by the consumer price index which reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. Theoretically, an increase in inflation would increase income inequality by lowering the purchasing power of the poor and reducing the real value of government aids that are usually not indexed to inflation (Law & Soon, 2020; Yue, 2011). It also reduces the purchasing power of those on fixed income. However, inflation could lower the income inequality if inflation raises the nominal income, leading to higher income tax payable by the rich (Yue 2011).

The study included trade openness to capture the extent of trade liberalization of a country. This was measured by the sum of export and import of goods and services as a percentage of GDP. The study expects the coefficients to be negative and significant. Although numerous publications show that trade openness is mainly associated with lower income inequality (see October 2007, World Economic Outlook; see also Woo, 2020), the overall literature is inconclusive (Krugman, 2008). Extensions of theoretical predictions suggest increased competition (Birdsall, 1998), incentives for more advanced skills (O. Blanchard & Giavazzi, 2003), and specialization (Francois & Nelson, 2003) are possible channels through which trade could reduce income inequality.

Table 5: Summary of Variable Definition, Expected Sign and Data Source

Variable	Definition	Expected Sign	Source
Income Inequality Lagged Income Inequality	Gini Coefficient Previous level of Income Inequality	+/-	SWIID Estimated
PSH	Public Spending on Health	-	WDI
PSE	Public Spending on Education	-	WDI
H_VRSTE	Efficiency of public spending on Health	-	Estimated
E_VRSTE	Efficiency of public spending in Education	-	Estimated
E_VRSTESQ	Squared term of efficiency of public spending on education	-	Estimated
Inst_Qty	Institutional Quality	-	Estimated
Economic Growth	GDP growth (annual %)	-	WDI
Foreign Direct Investment (FDI)	Foreign direct investment, net inflows (% of GDP)	-/+	WDI
Trade Openness	It captures the extent of trade liberalization in a country and it is measured by and Addition of export and import of goods and services (% of GDP)	-	Estimated
Urbanisation (Urban)	Urban population (% of total population)	+	WDI
Inflation	Inflation, consumer prices (annual %)	+/-	WDI

Source: Sikayena (2022)

Sources of Data

This study mainly used data from the World Bank's world development indicator (WDI) to analyze all the three objectives. This is because it contains most of the variables need for analysis in this study for the study selected countries. However, data on some other variables such as corruption was taken from the world governance indicator (WGI) and data on income inequality was also taken from the Standardised World Income Inequality Database (SWIID). It is measured using the Gini coefficient which is computed through coefficients of equalized household disposable income (post taxes and post transfer). SWIID data allow the comparison across countries because it standardizes observations collected from several sources by using a Bayesian approach (Solt, 2020). The study used data from 2006 to 2017 for its analysis. The study relied on sixteen (16) African countries for its analysis because of data availability. These are Burkina Faso, Burundi, Cape Verde, Cameroon, Ethiopia, Ghana, Guinea, Madagascar, Mali, Mauritania, Mauritius, Niger, Rwanda, Sao Tome and Principe, Senegal and Tunisia. These countries were selected based on data availability.

Chapter Summary

This chapter presents all the methodological issues for the study.it also provided the justification for choosing a quantitative analysis for the study and a detailed presentation of all the estimation techniques employed in each of the objectives set for the study. The non-parametric Data Envelopment Analysis was used to estimate the technical efficiency scores for public spending on human capital. Simar and wilson DEA bootstrapping model was used to determine the correlates of efficiency of public spending. In order to achieve the

second and the third empirical objective, the study adopted the GMM model due to its ability to recognize the country fixed effect and also solving the possible endogeneity issues in the model. The next chapter presents the results and discussion of the first empirical analysis, which focused on an assessment of efficiency of public spending on human capital.

CHAPTER FIVE

EFFICIENCY OF PUBLIC SPENDING ON HUMAN CAPITAL

Introduction

This chapter investigated efficiency of public spending on human capital in Africa. The chapter addressed four specific objectives. (a) to assess the efficiency of public health spending (b) to assess the efficiency of public education spending (c) to examine the correlates of efficiency of public health spending and (d) to examine the correlates of efficiency of public education spending. Data Envelopment Analysis (DEA) was employed to determine the efficiency of public spending levels for all the countries under study while the Simar and Wilson (2007) truncated DEA Bootstrapping Model was used to analyze the correlates of public spending efficiency on both health and education. The study also used margins plots to determine the non-linear relationship between economic growth and public spending efficiency as well as instituitional quality and public spending efficiency as dicpicted in figures 13 and 14 respectively.

The study used data from WDI and WGI since it contains all the necessary variables needed for analysis in this study. The variables used, their expected signs and definitions are well presented in table 3 in chapter four. The next section presents the summary statistics of the variables used, followed by the discussion of the results from the estimation. The last section presents the summary of the chapter.

Descriptive Statistics

The summary statistics of input and output variables used to estimate the efficiency scores for public spending on health and education was presented in

table 6.

Table 6: Descriptive Statistics on Input and Output Variables

Variable	Obs	Mean	Std.Dev.	Min	Max
PSH	192	5.389	1.686	2.887	11.276
PSE	192	4.335	1.491	1.581	10.678
GPSER	192	102.782	22.864	48.987	149.307
GSSER	192	46.004	25.778	10.599	99.904
Life_Exp	192	63.197	6.286	52.839	76.31
MMR	192	426.109	246.945	43	831
IMR	192	47.136	19.797	12.5	86.2

Source: Sikayena (2022)

Public Health spending as a percentage of GDP (PSH) was employed as an input resource for health efficiency. This had a mean of 5.389 percent and a range of 2.887 percent to 11.276 percent. This indicates that the selected countries spends an average of 5.389 percent of GDP on health. Additionally, Public Education Spending as a Percentage of GDP was used as an input variable for calculating Education Efficiency. This had a mean value of 4.335 percent, a minimum value of 1.581 percent, and a maximum value of 10.678 percent. From table 6, it can be concluded that the selected countries spend more on health than education. Studies such as Fonchamnyo & Sama (2016b); Herrera & Pang (2005) and Ouertani et al. (2018) also used public spending on health and public spending on education as input variables. Gross primary school enrolment recorded a means value of 102.782% with a minimum and maximum values of 48.987% and 149.307% respectively. Also, gross secondary school enrolment recorded a mean value of 46.004% and a minimum

and maximum values of 10.599% and 99.904% respectively.

The average Life Expectancy at birth recorded 63.197 years which is far lower than the global average of 72.6 years (WDI, 2019). The minimum and maximum values of 52.839 years and 76.31 years respectively. Maternal Mortality Ratio recorded an average 426.109 per 100,000 live birth with and minimum and maximum value 43 and 831 per 100,000 live birth respectively. Infant Mortality Ratio has an average of 47.136 per 1,000 live birth and a minimum and maximum of 12.5 and 86.2 per 1,000 live birth respectively.

Average Variable Returns to Scale Technical Efficiency Scores for Health and Education

This section achieves the first objective of the study. It examines efficiency of public spending on health and education in the selected countries. Table 7 presents the average variable returns to scale technical efficiency scores estimated for public spending on health and education in Africa. The overall average efficiency score for public spending on health was found to be 0.692 (69.2%) which is higher than the overall average efficiency score of 0.510 (51.0%) for education in the selected Africa countries. This may be attributed to the fact that health issues are considered a priority since it bothers on life, and therefore, there may be strict regulation and monitoring of funds allocated to the sector than in the education sector. The study found the overall spending on both health and education not to be efficient. This finding is consistent with other studies such as António Afonso et al. (2010); Fonchamnyo and Sama (2016a); Herrera and Pang (2005) which also found public spending on health and education to be inefficient in developing economies. This study also found efficiency of public spending on health to be higher than efficiency of public

spending on education. This implies that funds allocated to the health sector is efficiently utilized than funds allocated to the education sector.

Tunisia ranked 1st in health efficiency with a score of 97.2% but ranked 8th in education efficiency with a score of 46.5%. Mauritania ranked 2nd in health efficiency with a score of 95.6% but ranked 6th in education efficiency with a score of 62.5%. Mauritius ranked 3rd in both health and education efficiencies with a score of 91.9% and 73.3% respectively. On education efficiency, Madagascar tops the rank, but it is ranked 11th on health spending efficiency, while Guinea takes the 2nd position on education spending efficiency and still ranked 4th in health spending efficiency. Thus, Mauritius and seem to have high efficiency level in both health and education spending and are more likely to have high efficiency in overall human capital spending than Tunisia and Madagascar which tops on one side but performs poorly (or averagely) on the other side.

Table 7: Average Technical Efficiency Scores on Human Capital Development

Country	Health	Rank	Education	Rank
Tunisia	0.972	1st	0.465	8th
Mauritania	0.956	2nd	0.625	6th
Mauritius	0.919	3rd	0.733	3rd
Guinea	0.832	4th	0.771	2nd
Senegal	0.816	5th	0.352	15th
Cape Verde	0.8	6th	0.464	9th
Ghana	0.76	7th	0.366	11th
Mali	0.754	8th	0.466	7th
Ethiopia	0.741	9th	0.353	14th
Cameroon	0.672	10th	0.671	4th
Madagascar	0.628	11th	0.819	1st
Burkina Faso	0.517	12th	0.356	13th
Sao Tome and Principe	0.495	13th	0.359	12th
Niger	0.438	14th	0.372	10th
Rwanda	0.421	15th	0.644	5th
Burundi	0.348	16th	0.349	16th
AVG	0.692		0.510	

Source: Sikayena (2022)

Figure 11 presents efficiency of public spending on health trend from 2006 to 2017 for the selected countries. It indicated that few countries were able to achieve a score of one (1) in some of the years (see appendix 2). However, countries such as Burkina Faso, Burundi, Cape Verde, Cameroon, Ethiopia, Ghana, Madagascar, Niger, Rwanda, and Sao Tome and Principe were found

not to achieve a single efficiency score in the years under review. None of the countries showed a monotonic trend except Rwanda which showed an increasing trend in efficiency of public spending on health.

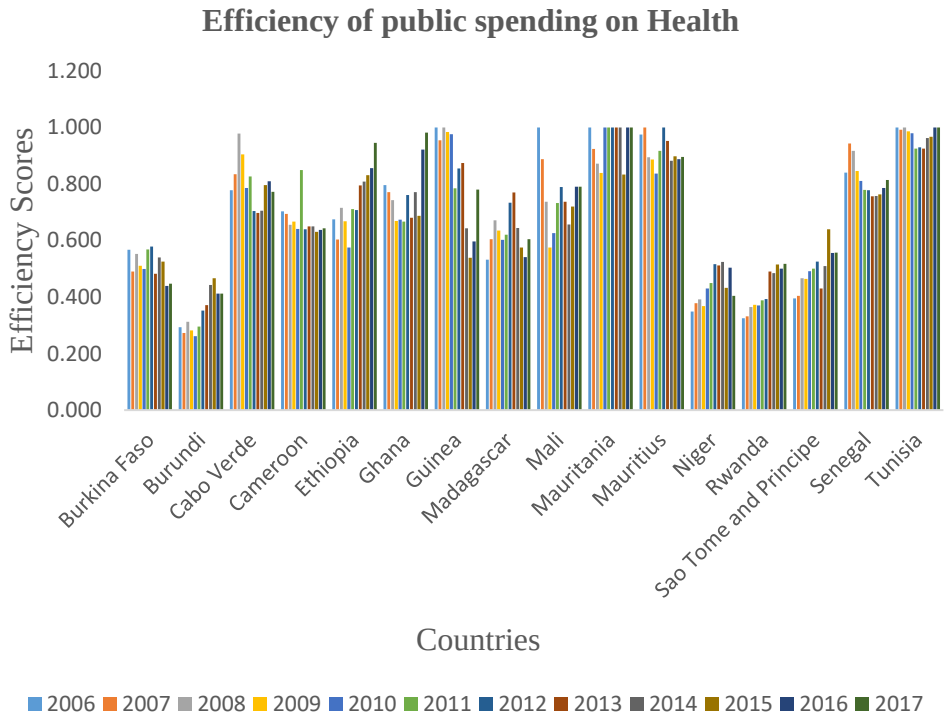

Figure 11: Efficiency of public spending on Health

Source: Sikayena (2022)

Figure ~~12~~ 12 also shows the trend analysis for efficiency of public spending on education in Africa. Like the health efficiency, few countries were found to achieve efficiency scores in some of the years for education. This includes countries such as Guinea, Madagascar, Mauritius, Rwanda and Tunisia. All the other countries were found not to be efficient in any of the years (see appendix 3).

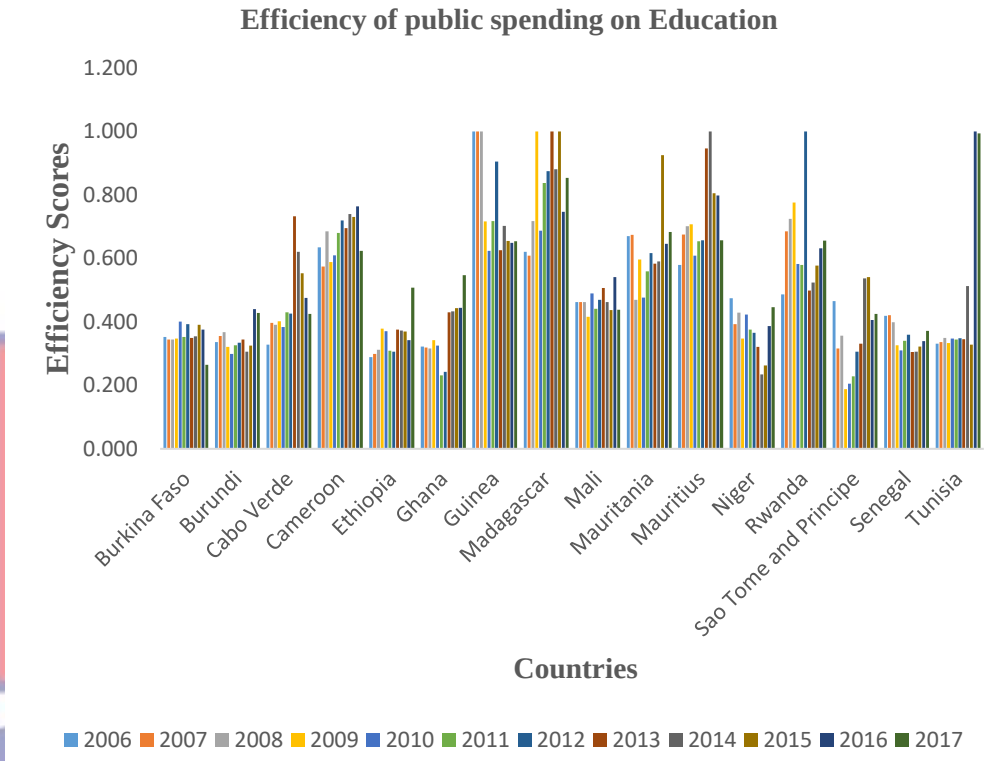

Figure 12: Efficiency of public spending on Education

Source: Sikayena (2022)

Table 8 presents the descriptive statistics of the variables used to analyze the Simarwilson DEA bootstrapping Regression Model.

Table 8: Descriptive Statistics on the Correlates of Efficiency of Public Spending

Variable	Obs	Mean	Std.Dev.	Min	Max
Inst. Quality	192	.369	.18	.071	.775
Inst. QualitySQ	192	.169	.154	.005	.6
Urbanization	192	.391	.178	.096	.72
Growth	192	.05	.032	-.039	.183
GrowthSQ	192	.003	.004	.002	.034
Govt_Exp	192	.148	.037	.06	.287
Inflation	192	.066	.074	-.278	.444
FDI	192	.048	.052	-.008	.421
Openness	175	.679	.25	.311	1.271

Source: Sikayena (2022)

From Table 8, the number of observation was 192 for all the variables except openness with a total observation of 175. Institutional Quality recorded

a mean value of (0.369) 36.9% and minimum and maximum values of (0.18) 18% and (0.775) 77.5% respectively. Urbanisation had a mean value of (0.391) 39.1% with (0.096) 9.6% and (0.72) 72% being minimum and maximum values respectively. This suggests that generally, the countries in the study sample are predominantly rural. For the Economic Growth variable recorded a mean value of (0.05) 5%, a minimum value of (-0.04) -4% and a maximum value of (0.183) 18.3%. Government Expenditure (Govt_Exp) has a mean value of (0.148) 14.8%, a minimum value of (0.06) 6.0% and a maximum value of (0.287) 28.7%. Inflation had a mean value of (0.66) 6.6% and minimum and maximum values of (-0.278) -27.8% and (0.444) 44.4% respectively. Foreign Direct Investment (FDI) recorded an average of (0.48) 4.8% and a minimum and maximum value of (-0.08) – 0.8% and (0.421) 42.1% respectively. Trade Openness (Openness) had a mean value of (0.679) 67.9% with a minimum and maximum values of (0.311) 31.1% and (1.271) 127.1% respectively. Thus, the presented statistics show high level of heterogeneity between the selected countries in the study sample.

Correlates of Efficiency of public spending on Human Capital

This section achieves the third and the fourth objectives of the first empirical objective which are (a) to determine the correlates of efficiency of public spending on health (b) to determine the correlates of efficiency of public spending on education. Table 9 presents the Simarwilson DEA bootstrapping model results which shows the correlates of efficiency of public spending on health and education in Africa. Tobit regression model was presented alongside for robustness check. There are four models contained in Table 9. The first and third models shows the determinants of variable return to scale technical

efficiency on health while models two and four show the determinants of efficiency of public spending on education. The dependent variables are efficiency of public spending on health and efficiency of public spending on education as presented in all the models. The results from the Tobit and Simarwilson DEA truncated estimations shows that the model is robust since the signs and significant levels for all the variables are the same. The coefficients for the statistically significant variables are almost the same. This shows the robustness of the model. The differences in the number of efficient DMUs (Countries) in the Simar and Wilson truncated DEA model explains the differences in the number of observations in the Simarwilson model in Table 9. This study is concentrated on the Simar and Wilson DEA bootstrapping model.

From Table 9, urbanisation was found to have a positive significant relationship with efficiency of public spending on health at 1% significant level. The results confirms a study conducted by Herrera-Aguilera and Ouedraogo (2018) who also found a positive significant relationship between efficiency of public spending and urbanisation. The result indicates that the clustering of agents makes it cheaper to provide certain services in urbanised areas.

Economic growth was only found to have a negative relationship with public spending efficiency on health at 5% alpha level, however, the squared term for economic growth was found to have a positive significant relationship with efficiency of public spending on health at 10% alpha level. This shows that public spending efficiency improves with economic growth with time. At the initial levels of economic growth much attention is not really given to spending efficiency, however, in order to consolidate economic growth with time, attention is given to public spending efficiency. From Table 9, a unit increase

in economic growth decreases efficiency of public spending on health by 1.565 unit but a unit increase in the squared term of economic growth increases efficiency of public spending on health by 12.479 units.

Government expenditure which measures the size of government was also found to have a negative significant relationship with efficiency of public spending in both health and education. The result indicates that a unit increase in government expenditure will lead to a decrease in efficiency of public spending on health outcomes by 2.012 units and education outcomes by 1.243 units, suggesting that public sector inefficiency may be higher in the educational sector than health sector for the study sample. This study confirms the findings of Gupta and Verhoeven (2001), Jarasuriya and Woodon (2003), and Afonso et al. (2003) who also found a negative relationship between government expenditure and public spending efficiency. In their study the authors suggested that the lesser the size of the government, the more the efficiency of government spending. However, the findings of this study contradict a study conducted by Xu et al. (2003) who found a positive relationship. Filmer and Pritchett (1999) also found no significant impact between government expenditure and public spending efficiency.

The study found foreign direct investment (FDI) to have a negative significant relationship with public spending efficiency in health at 5% alpha level but was not significant for public spending efficiency on education. This can be explained to mean that when a foreign investor squeeze out domestic firms and becomes monopolies, it can lead to productive inefficiency since they can set higher prices to cover up their inefficiencies.. However, this findings is not consistent with most of the studies in literature (Zhang et al. 2019). Zhang

et al., (2019) found a positive relationship between FDI and efficiency of government environmental spending. The study indicated that FDI that comes in the form of technological transfer has the tendency to improve health and education outcomes in the host country (Zhang et al., 2019).

The study found trade openness to be positively associated with efficiency of public spending on health at 1% alpha level and education at 5% alpha level. International trade has the tendency to make countries more competitive hence the need to be efficient in spending. A unit increase in openness has the tendency to improve efficiency of public spending on health and education by 0.596 unit at 1% significant level and 0.252 units at 5% significant level respectively, all other things being constant.

Finally, institutional quality was only found to have a significant relationship with public spending on education. However, the relationship was negative at 5% significant level. The study again found the squared term of institutional quality to have a positive significant relationship with public spending efficiency on education. This shows that institutional quality at the initial stages may have a negative relationship with public spending efficiency, however, with time, as institutions grow and become better, public spending efficiency can be ensured. As shown in table 9, a unit increase in institutional quality leads to a decrease in efficiency of public spending on education by 1.471 units at 1% alpha level but a unit increase in the squared term of institutional quality leads to an increase in efficiency of public spending on education by 1.467 unit at 1% alpha level, all other things being constant.

Table 9: Correlates of Efficiency of Public Spending on Health and Education

Variable	(1) Tobit Health	(2) Tobit Education	(3) Simarwilson Health	(4) Simarwilson Education
Urban	0.342***	-0.125	0.351***	-0.081
	(0.087)	(0.135)	(0.118)	(0.122)
Growth	-1.267**	-1.371	-1.565**	-0.153
	(0.586)	(0.913)	(0.789)	(0.921)
GrowthSQ	9.454**	3.053	12.479*	-2.635
	(4.363)	(6.797)	(6.999)	(6.597)
Govt_Exp	-2.058***	-1.446***	-2.012***	-1.243***
	(0.260)	(0.406)	(0.356)	(0.380)
Inflation	-0.045	0.048	-0.027	-0.191
	(0.161)	(0.250)	(0.200)	(0.229)
FDI	-0.665**	0.002	-0.909**	-0.077
	(0.270)	(0.421)	(0.370)	(0.388)
Openness	0.567***	0.261**	0.596***	0.252**
	(0.070)	(0.110)	(0.103)	(0.099)
Inst_Qty	-0.067	-1.365***	-0.098	-1.471***
	(0.239)	(0.372)	(0.313)	(0.359)
Inst_QtySQ	-0.172	1.347***	-0.064	1.467***
	(0.291)	(0.454)	(0.398)	(0.433)
_cons	0.614***	0.939***	0.598***	0.874***
	(0.072)	(0.112)	(0.099)	(0.110)
sigma_u:_cons	0.000	0.000		
	(0.015)	(0.027)		
sigma_e:_cons	0.111***	0.173***		
	(0.006)	(0.009)		
sigma:_cons			0.119***	0.152***
			(0.008)	(0.009)
Obs.	175	175	158	166
Pseudo R^2	0.000	0.000	0.000	0.000

Standard errors are in parenthesis
*** *p<0.01*, ** *p<0.05*, * *p<0.1*
Source: Sikayena (2022)

Figure 13 shows a graphical presentation of the relationship between economic growth and efficiency of public spending on health. The results shows that as economic growth increases with time, efficiency of public spending on health also increases.

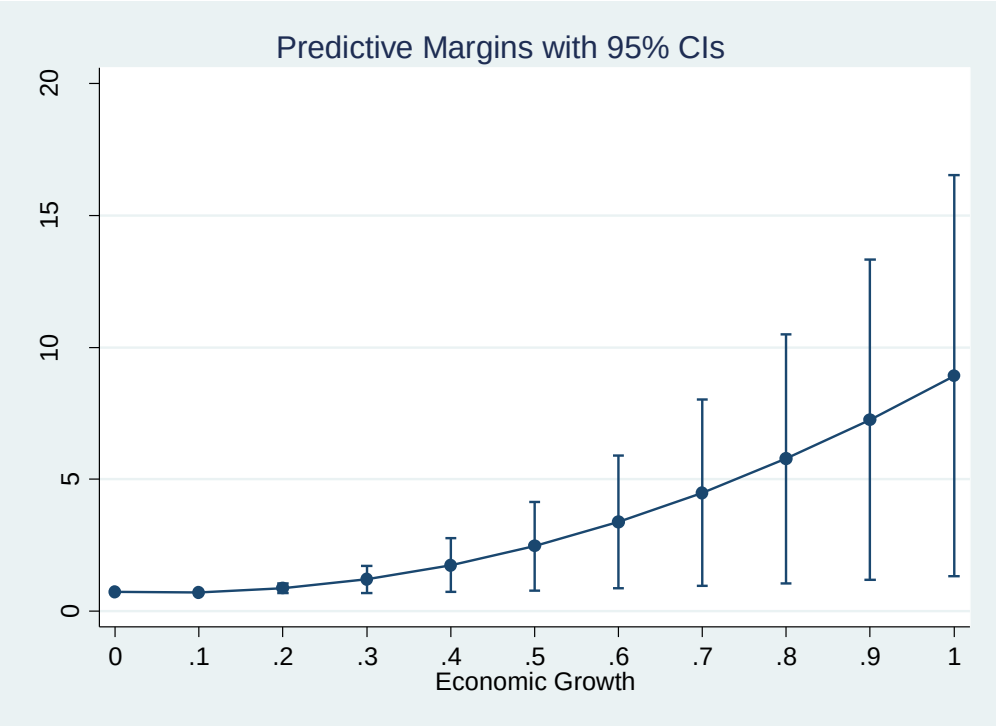

Figure 13: Margins Plot showing the Relationship between Economic Growth and Efficiency of Public Spending

Source: Sikayena (2022)

Figure 14 shows the relationship between institutional quality and efficiency of public spending on education. The results indicates that institutional quality initially shows a negative relationship with efficiency of public spending on education, however, at 50% level of institutional quality, the relationship changes to positive indicating that institutional quality is able to improve efficiency of public spending on education from 50% and above.

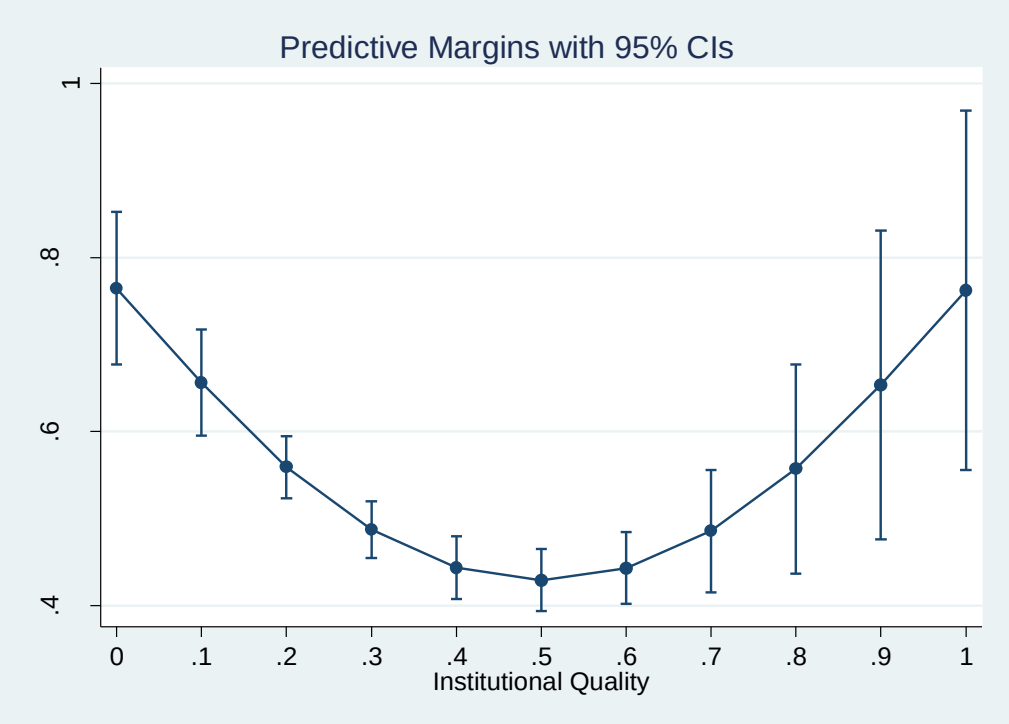

Figure 14: Margins Plot showing the Relationship between Institutional Quality and Efficiency of Public Spending

Source: Sikayena (2022)

Chapter Summary

This chapter presented results on public spending efficiency on human capital and its determinants. Data Envelopment Analysis (DEA) and Simarwilson DEA bootstrapping model were the main models used to achieve the objectives of the chapter. The study examined public spending efficiency on health and education and also determined the correlates of public spending efficiency on health and education. The DEA results revealed that the average public spending efficiency on both health and education were not efficient, however, public spending efficiency on health was found to be higher than public spending efficiency on education. The Simarwilson DEA bootstrapping model also found variables such as government expenditure and trade openness to be significant for both efficiency of public spending on health and education,

however, variables such as urbanization, economic growth, foreign direct investment were found to have a statistical significant relationship with public spending efficiency on health while institutional quality was found to have a statistical significant relationship with efficiency of public spending on education. Inflation was found not to have a significant relationship with both public spending efficiency on health and education. The next chapter presents results on the second empirical chapter.

CHAPTER SIX

EFFICIENCY OF PUBLIC SPENDING ON HUMAN CAPITAL AND PUBLIC DEBT

Introduction

This chapter presents results on the second empirical chapter. It investigated the relationship between public spending efficiency on human capital and public debt in Africa. The chapter dealt with four main objectives. (a) To examine the relationship between public spending efficiency on health and public debt. (b) To determine the threshold level beyond which public spending efficiency on health can reduce public debt. (c) To examine the relationship between public spending efficiency on education and public debt. (d) To determine the threshold level beyond which public spending efficiency on education can reduce public debt. This chapter also test two main hypotheses, (1) Efficiency of public spending on health has no effect on public debt (2) Efficiency of public spending on education has no effect on public debt.

System dynamic panel regression model was employed to examine the relationship between public spending efficiency on health and education and public debt while the Lind and Mehlum test for U-shaped and inverted U-shaped relationship was conducted to determine the threshold point for public spending efficiency on health and education. This chapter is divided into seven sections, the next section presents the summary statistics of the variables used for analysis while the third section presents the system dynamic regression results on public spending efficiency on health and public debt. The forth section presents the threshold analysis of public spending efficiency on health. The results on public spending efficiency on education and public debt and its threshold analysis were

presented in the fifth and the sixth section while the last section presents the summary of the chapter.

Summary Statistics

This section presents the summary statistics of the variables used for analysis to achieve the empirical objectives as presented in Table 10. The variable of interest is variable returns to scale technical efficiency of public spending on health (H_VRSTE) while the study controlled for public spending on health, broad money supply (BMS), growth, foreign direct investment (FDI), external Aid, openness, inflation, population growth (Pop_Growth), urbanization and corruption.

Table 10: Descriptive Statistics on Variables

Variable	Obs	Mean	Std.Dev.	Min	Max
PSH	192	5.389	1.686	2.887	11.276
BMS	192	36.425	25.107	9.402	114.191
Growth	192	4.957	3.204	-3.979	18.333
FDI	192	4.815	5.227	-.84	42.093
Ext_Aid	192	21.791	1.184	18.696	24.234
Openness	180	67.121	25.068	31.104	127.063
Inflation	192	6.567	7.414	-27.787	44.357
Pop_Growth	192	2.444	.885	.069	3.907
Urban	192	39.112	17.85	9.617	71.968
Corruption	192	40.575	21.208	1.42	80.29

Source: Sikayena (2022)

Efficiency of Public Spending on Health and Public Debt

This section presents the results on the first specific objective of the second empirical objective. To examine the effect of public health spending efficiency on public debt. The study used system dynamic model for its analysis. Table 11 shows the system dynamic panel results for public health spending efficiency and public debt in Africa. The rejection of the Wald test at 1% level of significance shows that efficiency of public spending on health is an important variable in explaining public debt among the other controlled variables. The Hansen test has a P-value greater than 0.05 which implies that there is no over identification of instrumental variable. Hence all the instruments are valid. The AR (2) test also shows that there is no autocorrelation in the second order of the first difference error. Since the probability values for the second order is greater than 0.05, the study fails to reject the null hypothesis that there is no autocorrelation in the first difference error of the estimated model. The study also rejects the null hypothsis that efficiency of public spending on health has no effect on public debt. It must be indicated that, all the variables in Table 11 met the expected signs except corruption which was even found not to be significant.

Table 11 presents three (3) different models to explain the relationship between public health spending efficiency and public debt. The first model presents the effect of public spending on health (PSH) on public debt while the second model presents the effect public health spending efficiency (H_VRSTE) on public debt. The third model is a nonlinear model which tries to identify effect of public health spending efficiency on public debt when all the variables are put together. The third model is the complete model for this study. The lag

of the dependent variable which is public debt was found to be significant and negative with a coefficient less than 1 in all the three (3) models. This implies that the model has the ability to converge back to long-run equilibrium in case of any disturbances. The coefficients of the lagged dependent variables shows the rate of convergence when there is a disturbance in the model. From Table 11, the annual convergence rate for the first, second and third models are 11.8%, 17.2% and 11.6% respectively until the models are finally corrected. The negative relationship also indicates that previous public debt accumulated has the tendency of compelling government to ensure fiscal discipline in order not to exacerbate the public debt situation. This can reduce the level of debt accumulated over the previous years

Public spending efficiency on health is the variable of interest in Table 11. Public spending efficiency on health was found to have a positive statistical significant association with public debt in both models 2 and 3 at 1% level of significance as shown in Table 11. The results indicated that a percentage increase in efficiency of public spending on health will increase public debt by 0.386 percent as depicted in model 2 and 5.906 percent unit as depicted in model 3 all at 1% level of significance, all other things being equal. However, the result from table 11 also shows that the squared term of Efficiency of public spending on health (H_VRSTE_SQ) was found to have a negative statistical significant relationship with public debt at 1% level of significance. This is consistent with the findings of Legesse and Guo (2020) who also found a positive association between efficiency and debt financing in the short-run but a negative association with debt financing in the long-run. This shows that efficiency of public spending on health can only reduce public debt at a certain threshold else the

negative impact of efficiency of public health spending on public debt will be difficult to observe as indicated in Table 11.

Public spending on health (PSH) was found to have a positive significant relationship with public debt in models 1 and 3. A percentage increase in PSH leads to an increase in public debt by 1.844 percent and 6.935 percent at 10% and 5% levels of significance respectively. A study conducted by Gargouri and Keantini (2016) which focused on the identification of the determinants of Europeans public debt indicated that an increase in government spending is likely to increase public debt when government revenue falls short of its rising expenditure. The study found military expenditure to have a positive significant relationship with public debt.

Increase in public spending on health contributes to an increase in the total spending by the government which in the long run will increase public debt if the high expenditure level of government is supported by loans. It is important to note that the effect in model 3 is higher than in model 1.

Other Covariates

At 1% alpha level, Broad Money Supply (BMS) was found to have a positive significant coefficient in all the three models. The results indicates that a percentage increase in BMS results in an increase in public debt by 0.312, 0.387 and 0.582 percentage points in models 1,2 and 3 respectively at 1% level of significance. This result contradicts the Keynesian school of thought, which claims that increasing money supply in a time of depression when both productive capacity and labor are idle due to a lack of aggregate demand is unlikely to raise prices, so an increase in money supply has the effect of increasing output or income. Given the rate of taxes, a rise in real income will

result in an increase in tax revenue, which will tend to lower the budget deficit in the short term. However, based on the findings in Table 11, it can be argued that increasing the money supply by external borrowing will raise a country's debt stock. Also, increase in money supply lowers the market interest rate making less expensive to borrow, hence a likely increase debt.

Economic Growth was found to have a negative statistical significant relationship with public debt. Growth was measured as the GDP per capita annual percentage. The result suggest that a percentage increase in growth will lead to a decrease in public debt by 2.221 percent in model 1, 2.943 percent in model 2 and 2.418 percent in model 3 at 1% levels of significance. This means that a higher economic growth is expected to reduce the public debt of a country. Several studies Abdul Razak (2018), Bayale (2020) as well as Briceño and Perote (2020) also found a negative statistically significant relationship between GDP growth rate and debt levels. An increase in growth indicates an increase in income hence a reduction in borrowing all other things being equal. However, Sinha et al. (2011) found GDP growth having a positive statistically significant relationship with public debt.

Foreign direct investment (FDI) was found to have a positive statistical significant relationship with public debt in models 2 and 3 at 1% levels of significance. The results revealed that a percentage increase in FDI will lead to an increase in public debt by 1.864 and 1.538 percentage points in the models at 1% level of significance all other things being equal. The results is not consistent with the studies conducted by Vighneswara (2015) who identified a negative statistically significant relationship between FDI and debt. However,

it can be concluded that when the net inflow of FDI is negative, public debt is likely to increase.

Only in model 1 did the results find a negative statistically significant association between external aid and public debt at a 1% level of significance. All other things being equal, a percentage increase in external aid will result in a drop in public debt by 0.053 percent at a 1% level of significance. This research backs up the Bulow-Rogoff model, which states that debt can be financed by aid if the debtor country can extort side payments from the government of an industrialized country. Aid in the form of debt relief can also dramatically reduce national debt. Most African countries obtained debt relief in the early 2000s under the World Bank's HIPC project, in which most African countries' debts were written off to relieve them of debt distress.

Table 11 shows that inflation had a negative significant relationship with public debt in model 2. The results shows that a percentage increase in inflation will decrease public debt by 0.468 percent at 5% level of significance. This mean an increase in the general price level is expected to decrease the rate of growth in public debt in the selected countries under study. An increase in general price level will lead to an increase in productivity, which will lead to a lower proportion of external debt in production. This findings confirms the studies conducted by Hilscher, Raviv and Reis (2017), Afonso and Jalles (2019) and Cherif and Hasanov (2018) all identified inflation to decrease public debt.

The growth rate of the population was found to have a positive statistical significant relationship with public debt in both models 1 and 3. The results shows that a percentage increase in population growth rate will increase public debt by 10.322 percent at 1% level of significance and 4.717 percent at 5% level

of significance in models 1 and 3 respectively. Population growth put pressure on existing social amenities hence the need to expand infrastructure which is always capital intensive. This increases government spending, therefore resulting in an increase in borrowing if the government is not able to raise enough revenue internally to support the rising expenditure. Studies such as Hauner and Kyobe (2010) proved that increase in population increases public debt since rise in population means the rise in health care services, educational facilities, more housing among others.

Urbanisation was found to have a negative significant relationship with public debt in this study.in model 1, a percentage increase in urban leads to a decrease in public debt by 0.493 percent at 1% significant level while in model 2, a percentage increase in urban leads to a decrease in public debt by 0.421 percent at 1% significant level all other things being equal. Urban areas are the center for industrial growth commerce, transportation, innovation, education, technological advances, and jobs. All other things being equal, the government is able to generate more tax revenues in the urban centers as compared to the rural areas, therefore an increase in government revenue will reduce the amount to be borrowed for developmental purposes hence a reduction in public debt all other things being equal. It is interesting to note that corruption was found not to be significant in all the three models.

Table 11: Efficiency of Public Spending on Health and Public Debt

Variables	(1) Public_Debt	(2) Public_Debt	(3) Public_Debt
L.Public_Debt	-0.118***	-0.172***	-0.116***
	(0.014)	(0.025)	(0.029)
PSH	1.844*		6.935**
	(0.980)		(2.777)
BMS	0.312***	0.387***	0.582***
	(0.102)	(0.064)	(0.068)
Growth	-2.221***	-2.943***	-2.418***
	(0.435)	(0.450)	(0.463)
FDI	-0.257	1.864***	1.358***
	(0.638)	(0.374)	(0.293)
Ext_Aid	-0.053***	-0.002	0.032
	(0.016)	(0.017)	(0.020)
Openness	0.009***	0.002	0.001
	(0.001)	(0.003)	(0.002)
Inflation	-0.239	-0.468**	-0.186
	(0.278)	(0.183)	(0.248)
Pop_Growth	10.322***	-4.134	4.717**
	(3.736)	(2.524)	(2.279)
Urban	-0.493***	-0.421***	0.003
	(0.113)	(0.080)	(0.120)
Corruption	0.043	-0.075	0.064
	(0.134)	(0.107)	(0.061)
H_VRSTE		0.386***	5.906***
		(0.145)	(1.244)
H_VRSTE_SQ			-4.181***
			(0.734)
_cons	-1.455***	0.542*	1.773***
	(0.417)	(0.322)	(0.519)
Obs.	168	168	168
Pseudo R^2	0.000	0.000	0.000
AR Test (1)	(0.036)	(0.045)	(0.017)
AR Test (2)	(0.842)	(0.777)	(0.448)
Hansen Test	(0.506)	(0.696)	(0.310)

Standard errors are in parenthesis
*** *p<0.01*, ** *p<0.05*, * *p<0.1*
Source: Sikayena (2022)

Threshold Analysis on Efficiency of public spending on Health and Public Debt

Table 12 shows the Lind and Mehlum test for U-shaped or inverted U-shaped relationship which was used to determine the threshold of efficiency of public spending on health needed to improve public debt.

Table 12: Lind and Mehlum test for U-shaped or Inverted U-shaped Relationship

Variable	Lower Bound	Upper Bound
Interval	0.262	1
Slope	3.717	-2.457
t-value	4.311	- 9.534
P>t	0.000	0.000
Overall test of presence of an Inverse U shape:		
t- Value =	4.31	
P>t =	0.0000138	
Extreme point:	0.7062461	
H1: Inverse U-shape		
H0: Monotone or U-shape		

Source: Sikayena (2022)

Table 12 shows the minimum level of public health spending efficiency which is enough to reduce the public debt. The Lind and Mehlum test was used to discover the threshold point for public health spending efficiency that has the ability to reduce public debt. As previously stated, the results obtained in the GMM model with positive and negative coefficients for efficiency of public spending on health and its squared term provided only the necessary condition that the relationship between efficiency of public spending on health and public

debt is inverted U-shaped. However, Lind and Mehlum test is used to determine an inverted U-shaped or U- shape association.

According to the study's findings, the overall inverted U-shaped test is significant at 1%, indicating that the null hypothesis of monotone or U- shape is rejected. The results from table 12 also revealed that at 1%, both the lower and upper bound slopes are significant. The positive sign on the lower bound slope indicates a positive slope, whereas the negative sign on the upper bound slope indicates a negative slope.

The results also indicated an extreme point of 70.62%. This indicates that, averagely, a minimum of 70.62% of efficiency of public spending on health is needed to reduce public debt. The study also presented a minimum efficiency of public spending on health to be 26.2% as shown by the lower bound and a maximum level of 100% as shown by the upper bound. The positive slope of 3.717 at the lower bound and a negative slope of 2.457 shows an inverted "U" shaped curve. This shows that efficiency of public spending on health will initially increase public debt but will eventually reduce public debt after the extreme point of 70.62% is achieved.

From Table 12, it can be concluded that, efficiency of public spending on health below the level of 70.62% increases public debt however, an efficiency level above 70.62% can reduce public debt. This is because an increase in efficiency of public spending increases productivity hence an increase in income which can be used to finance the increasing spending all other things being equal.

Efficiency of public spending on Education and Public Debt

Table 13 shows the system dynamic panel results for public education spending efficiency and public debt in the selected countries. The section seeks to investigate the relationship between public education spending efficiency and public debt. The number of observations were 168. The rejection of the Wald test at 1% level of significance shows that efficiency of public spending on education is an important variable in explaining public debt among the other controlled variables. The Hansen test has a P-value greater than 0.05 in all the three models which implies there is no over identification of instrumental variable. The AR-Test also shows that there is no autocorrelation in the second order of the first difference error. Since the probability values for the second order is greater than 0.05, the study fails to reject the null hypothesis that there is no autocorrelation in the first difference error of the estimated model.

Table 13 also presents three different model to explain the relationship between efficiency of public spending on education and public debt. The first model presents the effect of public education spending on public debt while the second model presents the effect of public education spending efficiency on public debt and the third model is a nonlinear model which tries to identify effect of public education spending efficiency on public debt when all the variables are put together. The study also rejects the null hypothsis that efficiency of public spending on education has no effect on public debt. It must be indicated that, all the variables in Table 13 met the expected signs.

The results from Table 13 also shows that the lag of the dependent variable which is public debt was found to be significant and negative with a coefficient less than 1 in all the three models. This implies that the model has

the ability to converge back to long-run equilibrium in case of any disturbances. The coefficients of the lagged dependent variables shows the rate of convergence when there is a disturbance in the model. From table 13, the annual convergence rate for the first, second and third models are 20.6%, 19.4% and 19.2% respectively until the models are finally corrected.

Efficiency of public spending on education (E_VRSTE) was found to have a positive statistical significant relationship with public debt in this study in both models 2 and 3 at 1% level of significance as shown in table 13. The results indicates that a percentage increase in efficiency of public spending on education will increase public debt by 0.366 percent as depicted in model 2 and 1.947 percent as depicted in model 3 all at 1% level of significance all other things being equal. However, it can be observed from table 13 that the squared term of public education spending efficiency (E_VRSTE_SQ) was found to have a negative statistical significant relationship with public debt at 1% level of significance. This indicates that public education spending efficiency initially may not influence public debt to reduce but can only reduce public debt at a certain threshold else the impact of public education spending efficiency on public debt will be difficult to observe. The reason is that, the impact of education on growth needs time since graduates are trained for a certain period of time.

Public spending on education (PSE) was found to have a positive significant relationship with public debt in model 1 but was found not to be significant in model 3. This implies that a percentage increase in public spending on education leads to an increase in 4.830 percent in model 1 at 1% level of significance. This is because an increase in government spending has

been found to increase public debt. This findings are consistent with the finding from a study conducted by (Gargouri & Keantini, 2016) which focused on the identification of the determinants of Europeans public debt. The study found military expenditure to have a positive significant relationship with public debt. Increase in public spending on education contributes to an increase in the total spending by the government which in the long run will increase public debt if the high expenditure level of government is supported by loans.

The broad money supply (BMS) was shown to have a positive significant connection in all three models at the 1% level of significance in each. At a 1% level of significance, a percentage increase in broad money supply causes a 0.694 percent rise in public debt in model 1, 0.753 percent increase in model 2, and 0.823 percent increase in model 3. This result contradicts the Keynesian school of thought, which claims that increasing money supply in a time depression when both productive capacity and labor are idle due to a lack of aggregate demand is unlikely to raise prices, so an increase in money supply has the effect of increasing output or income. Given the rate of taxes, a rise in real income will result in an increase in tax revenue, which will tend to lower the budget deficit in the short term. However, based on the findings in Table 13, it can be argued that increasing the money supply by external borrowing will raise a country's debt stock.

Table 13 also reveals a statistically significant negative link between growth and state debt. The annual percentage of GDP per capita was used to measure growth. At a 1% level of significance, the results suggest that a percentage increase in growth will result in a decrease in public debt of 2.849 percent in model 1, 2.781 percent in model 2, and 2.815 percent in model 3.

This suggests that increased economic growth is likely to reduce a country's public debt. Abdul Razak (2018), Bayale (2020) as well as Briceo and Perote (2020) found a statistically significant negative relationship between GDP growth rate and debt levels in several studies. According to Sinha et al. (2011), GDP growth has a statistically significant negative relationship with public debt in that increase in growth means increase in income which has the tendency of strengthening the fiscal position of a country.

Table 13 shows that in all three models, foreign direct investment (FDI) has a statistically significant positive association with public debt. All other things being equal, a percentage increase in FDI results in a rise in public debt of 1.454 percent in model 1, 1.287 percent in model 2, and 1.216 percent in model 3 at a 5% significant level. When the net inflow is negative, FDI is likely to raise public debt. This indicates that FDI outflows exceed FDI inflows. The findings did not match those of Vighneswara (2015), who discovered a negative statistically significant association between FDI and debt in his research.

At 1% significance levels, the study discovered that external aid has a negative statistical significant association with public debt in all three models. This suggests that a 1% increase in external aid will result in a 0.035 percent reduction in public debt in model 1, 0.049 percent in model 2, and 0.064 percent in model 3. This research backs up the Bulow-Rogoff model, which states that debt can be financed by aid if the debtor country can extort side payments from the government of an industrialized country. Aid in the form of debt relief can also dramatically reduce national debt. Most African countries obtained debt relief in the early 2000s under the World Bank's HIPC project, in which most African countries' debts were written off to relieve them of debt distress.

Table 13 identified population growth (Pop_Growth) to have a positive statistical significant relationship with public debt in both models 2 and 3. The results shows that a percentage increase in population growth rate will increase public debt by 9.802 percent at 10% level of significance in model 2 and 12.732 percent in model 3 at 5% level of significance. Population growth put pressure on existing social amenities hence the need to expand infrastructure which is always capital intensive. This increases government spending, therefore resulting in an increase in borrowing if the government is not able to raise enough revenue internally to support the rising expenditure. Studies such as Afflatet (2018) proved that increase in population increases public debt since rise in population means the rise in health care services, educational facilities, more housing among others. Other variables such as corruption, trade openness, and inflation were found not to be significant in Table 13.

Table 13: Efficiency of Public Spending on Education and Public Debt

Variables	(1) Public_Debt	(2) Public_Debt	(3) Public_Debt
L.Public_Debt	-0.206***	-0.194***	-0.192***
	(0.029)	(0.026)	(0.027)
PSE	4.830***		1.377
	(1.496)		(2.521)
BMS	0.694***	0.753***	0.823***
	(0.098)	(0.089)	(0.105)
Growth	-2.849***	-2.781***	-2.815***
	(0.495)	(0.477)	(0.465)
FDI	1.454***	1.287**	1.216**
	(0.520)	(0.594)	(0.523)
Ext_Aid	-0.035***	-0.049***	-0.064***
	(0.007)	(0.011)	(0.012)
Openness	-0.000	-0.002	-0.004
	(0.002)	(0.002)	(0.003)
Inflation	-0.171	-0.237	-0.041
	(0.136)	(0.160)	(0.161)
Pop_Growth	4.231	9.802*	12.732**
	(3.770)	(5.008)	(5.289)
Urban	-0.037	0.031	0.076
	(0.097)	(0.120)	(0.115)
Corruption	0.010	0.010	-0.029
	(0.116)	(0.124)	(0.134)
E_VRSTE		0.366***	1.947***
		(0.097)	(0.494)
E_VRSTE_SQ			-1.263***
			(0.380)
_cons	-0.329	-1.216**	-2.187***
	(0.254)	(0.478)	(0.617)
Obs.	168	168	168
Pseudo R^2	0.000	0.000	0.000
AR Test (1)	(0.037)	(0.005)	(0.020)
AR Test (2)	(0.961)	(0.169)	(0.654)
Hansen Test	(0.218)	(0.161)	(0.280)

Standard errors are in parenthesis

*** *p<0.01*, ** *p<0.05*, * *p<0.1*

Source: Sikayena (2022)

Threshold Analysis on Efficiency of public spending on Education and Public Debt

Table 14 shows the Lind and Mehlum test for U- shape. This presents the results on the threshold analysis conducted to identify the minimum public education spending efficiency needed to reduce public debt. It answers the objective that seeks to determine the minimum level of efficiency of public spending on education that can reduce public debt. The results of the study indicates that the overall P- value was significant at 5% showing the rejection of the null hypothesis of monotone while the P- values of both the lower bound was significant at 1% and upper bounds was found to be significant at 5%. The lower bound showed a positive sign while the upper bound showed a negative sign implying a positive and negative slopes respectively.

The results from Table 14 indicates that, averagely, a country need a minimum of 77.10% of efficiency of public spending on education to reduce public debt as indicated by an extreme value of 0.7709. The results indicates that the minimum efficiency of public education spending for the countries was 18.8% as shown by the interval for lower bound and the highest was 100% as shown by the interval value for upper bound. The slopes shows that efficiency of public spending on education will initially increase public debt but will eventually reduce public debt after the extreme point of 77.10%. The positive slope of 1.471 and a negative slope of 0.578 shows an inverted U- shape curve.

From Table 14, it can be concluded that, efficiency of public spending on education below the level of 77.10% increases public debt, however, an efficiency level above 77.10% can reduce public debt. An increase in efficiency of public spending on education increases productivity hence an increase in

income which can be used to finance the increasing spending all other things being equal.

Table 14: Lind and Mehlum Test for U-shaped or Inverted U-shaped Relationship

Variable	Lower Bound	Upper Bound
Interval	0.188	1
Slope	1.471	-0.578
t-value	4.060	-1.707
P>t	0.000	0.045
Overall test of presence of an Inverse U shape:		
t-value =	1.71	
P>t =	0.0449	
Extreme point:	.7709732	
H1: Inverse U-shape		
H0: Monotone or U-shape		

Source: Sikayena (2022)

Chapter Summary ~~of the Chapter~~

This chapter had four objectives. In the first objective, the study assessed the effect of public health spending efficiency on public debt, in the second objective, the study determined what level of public health spending efficiency was needed to reduce public debt, and third objective dealt with the effect of public education spending efficiency on public debt while the last objective determined the level of public education spending efficiency needed to reduce public debt.

Using the system GMM and Lind and Mehlum test, the study identified efficiency of public spending in both health and education to have a positive

statistical significant relationship with public debt while the turning point for efficiency of public spending on health was found to be 70.62%. The study also found the turning point for efficiency of public spending on education to be 77.10%. Other control variables such as growth, external aid, population growth, urban, FDI, Inflation were found to influence public debt. However, corruption was found not to be significant in all the models estimated in this study.

CHAPTER SEVEN

EFFICIENCY OF PUBLIC SPENDING ON HUMAN CAPITAL AND INCOME INEQUALITY

Introduction

The chapter focused on two key objectives. (a) To assess the relationship between the efficiency of public spending on health and income inequality. (b) To assess the relationship between efficiency of public spending on education and income inequality. This chapter was divided into five sections. The descriptive statistics for the variables are presented in the next section, followed by the dynamic panel regression results, which show the relationship between efficiency of public spending on health and education and income inequality, and the threshold analysis of efficiency of public spending on education and income inequality. The chapter's summary is presented in the final section.

Descriptive Statistics

The descriptive statistics of the variables employed in the analysis are shown in this section. To determine their association, a scatter plot on the efficiency of public spending on health and education and income inequality was employed. In the selected countries under study, income inequality (Income_Inq) has 144 as the total observation, with 0.33 and 0.515 as the minimum and maximum levels of income inequality. The mean value is 0.414. According to the World Inequality Data Base, the average income inequality in Africa from 2006 to 2017 shows that the continent is an extreme income inequality region by worldwide standards, with a top 10% national income share of 54% and a bottom 50% share of less than 10%. Africa has the greatest disparity between the average incomes of the top 10% and the bottom 50%.

Average incomes of the richest 10% are roughly 30 times higher than those of the poorest 50%, well above the number found in comparable extreme inequality regions such as the Middle East, India, or Brazil, where the disparity is approximately 20 times.

Table 15: Descriptive Statistics of the Variables

Variable	Obs	Mean	Std.Dev.	Min	Max
Income_Inq	144	.414	.048	.33	.515
PSE	192	.043	.015	.016	.107
PSH	192	.054	.017	.029	.113
Edu_VRSTE	192	.51	.2	.188	1
Health_VRSTE	192	.692	.208	.262	1
E_VRSTE2	192	.3	.243	.035	1
Inst_Qty	192	.369	.18	.071	.775
Growth	192	.05	.032	-.04	.183
FDI	192	.048	.052	-.008	.421
Urban	192	.391	.178	.096	.72
Inflation	192	.066	.074	-.278	.444
Openness	175	.679	.25	.311	1.271

Source: Sikayena (2022)

Relationship between Efficiency of public spending on Human Capital and Income inequality

In order to show a visual representation of the two variables, the study presented a scatter plot that show the association between efficiency of public spending on human capital (Health and Education) and income inequality. The results in Figure 15 showed a negative relationship between efficiency of public spending on health and income inequality.

Figure 15: Relationship between Efficiency of public spending on Health and Income Inequality

Source: Sikayena (2022)

Figure 16 shows a positive relationship between efficiency of public spending on education and income inequality.

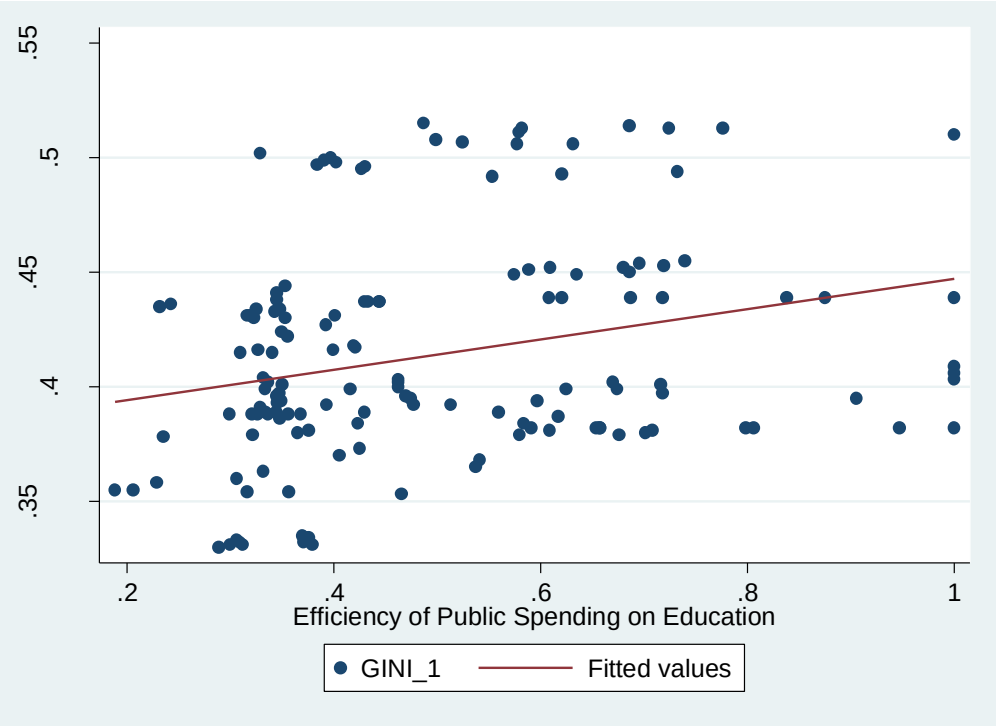

Figure 16: Relationship between Efficiency of public spending on Education and Income Inequality

Source: Sikayena (2022)

Efficiency of public spending on Health and Income Inequality

This section discusses the dynamic regression results as presented in Table 16. It shows the relationship between efficiency of public spending on health and income inequality. The study also rejects the null hypothsis that efficiency of public spending on health has no effect on income inequality. It must be indicated that, all the variables in Table 16 met the expected signs except institutional quality.

Table 16: Efficiency of Public Spending on Health and Income Inequality

Income_Inq	Coef.	St.Err.	t-value
L.Income_Inq	0.108*	0.060	1.79
PSH	0.033	0.174	0.19
H_VRSTE	-0.139***	0.027	-5.18
Inst_Qty	0.079***	0.016	4.99
Growth	-0.154	0.146	-1.06
FDI	0.210*	0.107	1.96
Urban	0.247***	0.016	15.44
Inflation	0.102***	0.034	2.99
Openness	-0.080***	0.018	-4.49
Constant	0.397***	0.043	9.31
Number of obs		100	
Pseudo R^2		0.000	
AR Test (1)		0.005	
AR Test (2)		0.648	
Hansen Test		0.518	

*** $p<0.01$, ** $p<0.05$, * $p<0.1$
Source: Sikayena (2022)

From Table 16, the study rejected the Wald test at 1% level of significance showing that efficiency of public spending on health is an important variable in explaining income inequality among the other controlled variables. The Hansen test has a P-value being insignificant which implies that there is no over identification of instrumental variable. Hence all the instruments

are valid. The AR (2) test also shows that there is no autocorrelation in the second order of the first difference error. Since the probability values for the second order is greater than 0.05, the study fails to reject the null hypothesis that there is no autocorrelation in the first difference error of the estimated model.

The lag of the dependent variable (income inequality) was found to be less than one and having a significant positive relationship with income inequality. This implies that previous income inequality worsens current income inequality. A unit increase in the lagged dependent variable leads to an increase in income inequality by 0.108 unit at 10% alpha level all other things being constant.

The coefficient of efficiency of public spending on health which is the variable of interest was found to have negative statistical significant relationship with income inequality at 1% level of significance. From Table 16, a unit increase in efficiency of public spending on health leads to a decrease in income inequality by 0.139 unit, all other things being equal. This implies that efficiency in public spending on health has the tendency to improve income inequality. Efficiency in spending prevents wastage which can lead to economic growth. Increase in growth when translated into increase in employment and income can reduce income inequality.

Foreign direct investment was found to have a positive statistical significant relationship with income inequality. A unit increase in foreign direct investment leads to an increase in income inequality by 0.210 unit at 10% alpha level. Foreign direct investment inflows can contribute to greater income inequality by worsening the wage gaps between the foreign and domestic firms and increased wages of skilled employees in corresponding sectors. This results

is consistent with the findings of Farhan, Azman-Saini, and Law (2014) who also found a positive relationship between foreign direct investment and income inequality.

Urbanisation was found to also have a positive statistical significant relationship with income inequality as expected. This is because the wage difference between jobs in urban areas is normally higher than the rural areas hence an increase in wage disparities causes income inequality. From Table 16, a unit increase in urbanisation leads to an increase income inequality by 0.247 unit all other things being equal.

The study found inflation to have a positive statistical significant relationship with income inequality at 1% alpha level. A unit increase in inflation leads to an increase in income inequality by 0.102 unit all other things being equal. The positive relationship can be explained in terms of the fact that, when inflation occurs, prices of goods and services increases faster than increases in money wages. Therefore, inflations leads to shift of income away from wage earners, and toward profits earners. On this ground, inflation is claimed to increase income inequality because it hurts the poor relatively more than the rich (Thalassinos et al. 2012). Other studies such as Monnin (2014), Nantob (2015), Balcilar et al. (2018) and Saimi-Namini and Hudson (2019) have all identified a positive relationship between inflation and income inequality. Inflation also reduces the purchasing power of people with fixed income, hence making them worse off.

Trade openness was found to have a negative statistical significant relationship with income inequality at 1% alpha level. The result shows that a unit increase in trade openness leads to a decrease in income inequality by 0.080

unit all other things being equal. Local industries that increases productivity because of increase in export can increase employment of labour which reduces poverty and income inequality. Trade openness could also lead to faster growth in average income and if that growth, in turn, proportionately increases incomes of the poor, it will lead to a decreased in absolute poverty.

The found institutional quality to have a positive significant relationship with income inequality. Theoretically, a quality institutional mechanism have the potential to reduce inequality, however, this study found a positive significant relationship between institutional quality and income inequality. This is consistent with the study by Odusola et al. (2019) who explained that, institutional procecess in Africa breeds corruption, political clientelism, beraucracy, political instability and other irreguralities that undermines property right, therefore, contribute to high income inequality in Africa.

Efficiency of public spending on Education and Income Inequality

This section discusses the dynamic regression results as presented in Table 17. It shows the relationship between efficiency of public spending on education and income inequality. The study rejects the null hypothsis that efficiency of public spending on education has no effect on income inequality. It must be indicated that, all the variables in Table 17 met the expected signs.

Table 17: Efficiency of Public Spending on Education and Income Inequality

Income_Inq	Coef.	St.Err.	t-value
L.Income_Inq	-0.302***	0.032	-9.38
PSE	3.353***	0.186	18.02
Edu_VRSTE	1.166***	0.103	11.30
E_VRSTESQ	-0.734***	0.087	-8.43
Inst_Qty	0.020	0.023	0.87
Growth	0.034	0.079	0.43
FDI	0.351***	0.062	5.65
Urban	0.192***	0.010	19.18
Inflation	-0.003	0.054	-0.05
Openness	-0.171***	0.009	-18.64
Constant	0.043*	0.024	1.78
Number of obs		100	
Pseudo R^2		0.000	
AR Test (1)		0.044	
AR Test (2)		0.200	
Hansen Test		0.749	

*** *p<0.01*, ** *p<0.05*, * *p<0.1*

Source: Sikayena (2022)

From Table 17, the study rejected the Wald test at 1% level of significance showing that efficiency of public spending on health is an important variable in explaining public debt among the other controlled variables. The Hansen test has a P-value being insignificant which implies that

there is no over identification of instrumental variable. Hence all the instruments are valid. The AR (2) test also shows that there is no autocorrelation in the second order of the first difference error. Since the probability values for the second order is greater than 0.05, the study fails to reject the null hypothesis that there is no autocorrelation in the first difference error of the estimated model.

The lag of the dependent variable (income inequality) was found to be less than one and having a statistically significant negative relationship with income inequality. This implies that the model has the ability to converge back to equilibrium in case of any external shock. The coefficient of the lagged dependent variable shows the rate of convergence when there is a disturbance in the model. From Table 17, the annual convergence rate was 30.2%. It is important to note that government and policy makers can implement pro-poor policies that bridges the income gap when previous income inequality is high.

Efficiency of public spending on education which was the variable of interest in Table 17 was found to have a positive statistical significant relationship with income inequality at 1% alpha level all other things being constant. The results shows that a unit increase in efficiency of public spending on education will lead to an increase in income inequality by 1.166 units all other things being constant. However, the squared term of efficiency of public spending on education was found to have a negative statistical significant relationship with income inequality at 1% alpha level. A unit increase in efficiency of public spending on education will lead to a decrease in income inequality by 0.734 unit all other things being constant. The result in Table 17 implies that efficiency of public spending on education will initially increase income inequality but will eventually decrease income inequality. This confirms

to the composition effect and compression effect theory of education expansion by (Knight & Sabot, 1983).

Foreign direct investment was found to have a positive statistical significant relationship with income inequality at alpha level of 1%. A unit increase in foreign direct investment will lead to an increase in income inequality by 0.351 unit all other thing being equal. According to Farhan, Azman-Saini and Law (2014) foreign direct investment can increase income inequality due to increased wage of skilled employees in the corresponding sectors.

The study also found urbanisation to have a positive statistical significant relationship with income inequality at 1% level of significance. A unit increase in urbanization leads to an increase in income inequality by 0.192 units all other things being equal. Urbanisation can increase income inequality due to the wage differences between jobs in urban areas and rural areas. It is also important to note that, employment opportunities in urban areas are higher than rural areas, therefore urban dwellers are more likely to reduce absolute poverty than their rural counterparts.

Trade openness was found to have a negative statistical significant relationship with income inequality at 1% level of significance. This implies that increase in international trade has the tendency to reduce income inequality. This happens when trade openness enhances employment opportunities for workers to earn income. The results in Table 17 also showed that variables such as institutional quality, growth and inflation was found not to be statistically significant in this study.

Finally, the study found a positive significant relationship between

public spending on education and income inequality at 1% alpha level. A unit increase in public spending on education will lead to an increase in income inequality by 3.353 units all other things being equal. Spending on education do not yield instant impact on the individual except for some time, therefore public spending on education is likely to have a positive effect on inequality until the individual is fully educated to qualify and enrolled in an income generating venture.

Lind and Mehlum test for U-shaped or inverted U-shape

Table 18 employed Lind and Mehlum test for U-shape or inverted U-shape to determine the extreme point for efficiency of public spending on education beyond which income inequality can be reduced. The result for the GMM model only provides the necessary conditions on the relationship between efficiency of public spending on education and income inequality. Lind and Mehlum (2010) indicated that to determine an inverted U-shape or U- shape relationship involves conducting Lind and Mehlum test. The result from Table 18 shows that, the overall U-shaped test is significant at 1%, indicating that the null hypothesis of monotone or U-shape is rejected. The results from Table 18 also revealed that at 1%, both the lower and upper bound slopes are significant. The positive sign on the lower bound slope indicates a positive slope, whereas the negative sign on the upper bound slope indicates a negative slope.

The results also indicated an extreme point of 79.4%. This indicates that, averagely, a minimum of 79.4% of efficiency of public spending on education is needed to reduce income inequality. The study also presented a minimum efficiency of public spending on education to be 18.8% as shown by the lower bound and a maximum level of 100% as shown by the upper bound. The positive

slope of 0.889 at the lower bound and a negative slope of 0.303 shows an inverted "U" shaped curve. This shows that efficiency of public spending on education will initially increase income inequality but will eventually reduce income inequality after the extreme point of 79.4% is achieved.

From Table 18, it can be concluded that, efficiency of public spending on education below the level of 79.4% increases income inequality however, an efficiency level above 79.4% can reduce income inequality. This is consistent with the composition effect and compression effect theory of education expansion by (Knight & Sabot, 1983)

Table 18: Lind and Mehlum Test for U-shape or Inverted U-shape Relationship

	Lower Bound	Upper Bound
Interval	0.188	1
Slope	0.889	-0.303
t-value	12.611	-4.213
P>T	0.000	0.000

Overall test of presence of an Inverse U shape:
t-value = 4.21
P>t = 0.000276
Extreme point: 0.7937722
H1: Inverse U shape
H0: Monotone or U-shape

Source: Sikayena (2022)

Chapter Summary

This chapter presented the results and the discussion of the effect of efficiency of public spending on human capital on income inequality in Africa. Specifically, (a) examined the effect of efficiency of public spending on health

on income inequality, (b) examined the effect of efficiency of public spending on education on income inequality and determined the threshold that reduces income inequality. The study used dynamic panel regressions for it analysis. The study also used data from WDI and SWIID for it analysis.

The results of the study showed a negative significant relationship between efficiency of public spending on health and income inequality but a positive statistically significant relationship between efficiency of public spending on education and income inequality. However, the squared term of efficiency of public spending on education was found to have a negative statistically significant relationship with income inequality. It was also revealed that, efficiency of public spending on education improves income inequality beyond 79.4%.The next chapter presents the findings, conclusion, recommendations and suggestions for future research for this study.

CHAPTER EIGHT

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter presents the summary for the study, provide the main conclusions and offer policy recommendations for the study. The chapter is divided into five sections, the next section presents the summary of the entire study while the third section presents the main conclusions for the research. Policy recommendations are presented in the fourth section while the last section presents suggestions for future research.

Summary

Over the years, the debate among academics and policy makers have focused on economic growth and poverty reduction in Africa with little emphasis on the extent of income inequality across the continent. Although most Africa countries have experienced strong economic growth in recent times, human development, poverty and income inequality have not seen commensurate progress as expected. This has sparked the attention of academics and researchers to study into the issues of inequality in Africa which is seen as among the main causes of the weak effect of macroeconomic growth on poverty reduction. The debt crises in Africa in recent times has also attracted a lot attention among researchers and academics and planned institutions. A report from the World Bank (2018) indicated that, almost 40% of the countries in Africa are at risk of a major debt crisis. This calls for a swift intervention from policy makers to solve these macroeconomic problems.

Using data mainly from WDI, WGI and SWIID, the study investigated issues of efficiency of public spending on human capital because human capital development enhances productivity, hence economic growth. The study also investigated the relationship between efficiency of public spending on human capital and public debt and income inequality in Africa. The study addressed how efficiency of public spending on human capital can improve public debt and income inequality. The study centered its attention on three main areas; (a) efficiency of public spending on human capital (b) efficiency of public spending on human capital and public debt and (c) efficiency of public spending on human capital and income inequality.

The first empirical objective investigated four specific objectives; (a) to examine efficiency of public spending on health (b) to examine efficiency of public spending on education (c) to determine the correlates of efficiency of public spending on health and (d) to determine the correlates of efficiency of public spending on education

The results of the study suggest that on the average , public spending on both health and education is not efficient. The study also identified that efficiency of public spending on health is averagely higher than efficiency of public spending on education. The overall average efficiency score for health spending is 69.2% while that of education is 51.0%. Tunisia ranked first among its peers with an average health efficiency score of 97.2% while Madagascar ranked first among its peers with an average education efficiency score of 81.9%.

Though none of the countries recorded an average efficiency score of one (1) few countries like Ghana, Tunisia, Mauritania and Mauritius were able to achieve a score of one (1) in some of the years. However, countries such as Burkina Faso, Burundi, Cape Verde, Cameroon, Ethiopia, Ghana,Madagascar, Niger, Rwanda, and Sao Tome and Principe were found not to achieve a single efficiency score in the years under review. None of the countries showed a trend except Rwanda which showed an improvement in efficiency of public spending on health. On education spending, countries such as Madagascar, Rwanda, and Tunisia were found to have recorded an efficiency score of one (1) in some of the years though having an average efficiency score of less than one (1). Mauritius and Madagascar seem to have high efficiency level in both health and education spending and are more likely to have high efficiency in overall human capital spending than Tunisia and Madagascar which tops on one side but performs poorly (or averagely) on the other side.

On the correlates of efficiency of public spending, the study found government expenditure and openness to influence both efficiency of public spending on health and education. Urbanisation, economic growth, foreign direct investment were found to influence only efficiency of public spending on health while institutional quality was found to influence only public spending on education. The study also found that, economic growth increases efficiency of public spending on health in the long run while institutional quality was found to increase efficiency of public spending on education in the long run.

Empirical objective two focused on the effect of efficiency of public spending on human capital on public debt in Africa. Two hypothesis were tested under the second empirical objective; (a) efficiency of public spending on health have significant effect on public debt (b) efficiency of public spending on education have a significant effect public debt. The study also did a threshold analysis to determine the extreme points of efficiency of public spending on health and education necessary to improve public debt in Africa. The study used data from WDI and WGI for its analysis to achieve objectives in the second empirical chapter. System dynamic panel was employed to analyze how efficiency of public spending on human capital can improve public debt while Lind and Mehlum test for U-shape or inverted U-shape was used to determine the turning points in both efficiency of public spending on health and education necessary to improve public debt.

The results showed efficiency of public spending on health had a positive statistical significant relationship with public debt, however, the squared term had a negative statistical significant relationship with public debt. The threshold analysis indicated that, efficiency of public spending on health below 70.62% increases public debt, however, beyond the extreme point of 70.62%, efficiency of public spending on health can improve public debt. This means that efficiency in public health spending level above 70.62% is required to improve public debt in the selected countries.

An increase in public spending on health was found to increase public debt. Other variables such as broad public spending on health, money supply, economic growth, population growth and foreign direct investment were found to have statistical significant relationship with public debt.

Efficiency of public spending on education was found to have a positive statistically significant relationship with public debt however, the squared term had a negative statistically significant relationship with public debt. The threshold analysis indicated that efficiency of public spending on education must be above 77.10% to improve public debt.

The relationship between efficiency of public spending on human capital and income inequality was the focus of empirical objective three. Two main hypotheses were tested; (a) to examine the relationship between efficiency of public spending on health and income inequality (b) to examine the relationship between efficiency of public spending on education and income inequality. The study also tested for the composition effect and compression effect theory of education expansion by (Knight & Sabot, 1983).

The study used data from WDI, WGI and SWIID for its analysis to achieve empirical objective three. Dynamic panel model was employed to analysis the relationship between efficiency of public spending on human capital and income inequality while Lind and Mehlum test for U-shape or inverted U-shaped was used to determine the turning point for efficiency of public spending on education that improves income inequality.

The result of the study identified efficiency of public spending on health to have a negative statistically significant relationship with income inequality. The study also found efficiency of public spending on education to have a positive statistically significant relationship with income inequality. However, the squared term of efficiency of public spending on education was found to have a negative statistically significant relationship with income inequality. This confirmed the composition effect and compression effect theory of

education expansion by (Knight & Sabot, 1983). Other control variables such as foreign direct investment, urbanisation, inflation and trade openness were found to have a statistically significant relationship with income inequality.

Conclusions

The purpose of this study was to examine how Efficiency of public spending on Human Capital influences Public Debt and Income Inequality. With respect to public spending efficiency on human capital, the study found efficiency of public spending on both health and education is not efficient. The results of the study revealed that, efficiency of public spending on health and education is not efficient. The selected countries were found to be more efficient in health spending than in education spending. The trend analysis showed that none of the countries showed a monotonic trend except Rwanda which showed an increasing trend in efficiency of public spending on health.

The study identified government expenditure and openness to increase both public spending efficiency on both health and education. However, the study identified foreign direct investment, urbanization, economic growth to increase efficiency of public spending on health while variables such as institutional quality to influence public spending efficiency on education. Inflation was found not to influence both public spending efficiency on health and education.

Regarding the relationship between efficiency of public spending on human capital and public debt, the study identified public spending efficiency on both health and education to have a non-linear relationship with public debt. Higher levels of efficiency of public spending on both health and education is required to reduce public debt.

On the relationship between public spending efficiency on human capital and income inequality, the study also identified efficiency of public spending on both health and education to reduce income inequality. However, while the relationship between efficiency of public spending on health and income inequality is monotonic, the relationship between efficiency of public spending on education and income inequality is non-linear.

Recommendations

Based on the empirical evidences and the conclusions from the study, the following recommendations were made for considerations by the ministries of health and education. Also, the recommendation will be helpful to the central government in its policy interventions. In order to ensure efficient spending on human capital;

1. The ministries in charge of education should ensure an institutional quality rating of at least 50% to improve efficiency of public spending on education. This is because strong and quality institutions prevents wastage and also ensures that resources are used for the collective benefit of society.
2. African governments must ensure trade openness since it was found to improve efficiency in spending on both health and education. Competition from trade openness encourages local producers and government to produce efficiently to remain competitive.
3. Government should sustain the rate of economic growth over time to improve efficiency of public spending on health.
4. Government should provide the necessary infrastructure to ensure growth in urbanization to enhance efficiency of public spending on

health. Urban citizens are normally enlightened when compared to their rural counterparts, therefore can put government on tract through constructive criticism and suggestions in terms of ensuring efficiency in public spending.

5. Government and the ministries in charge of health should ensure that on the average, efficiency of public spending on health goes beyond 70.62% from its current level to improve public debt.
6. Government and the ministries in charge of education must ensure that on the average, efficiency of public spending on education goes beyond 77.1% from its current level to improve public debt.
7. The government and the ministries in charge of health must ensure efficiency of public spending on health to improve income inequality.
8. The government and the ministries in charge of education must ensure that efficiency of public spending on education must go beyond 77.4% to improve income inequality.

Suggestions for Future Research

Having come this far with the study and specifically with the analysis, the following are suggestions for further research since the study could not address all issues on the subject matter. On the first empirical objective, Future study can consider other important sectors like Agriculture, Administration, Military spending and Research and Development, also future research can extend the study to all African countries to get a clear view of the level of efficiency of public spending. On the second empirical objective, future studies can go beyond the sectors and consider looking at the effect of public spending efficiency as a whole on public debt to get a holistic view as to how government

spending efficiency can help improve public debt in Africa. Other studies can also look at the components of government spending such as capital and current spending on public debt. On the third empirical objective, future studies can use the theil index to explain how efficiency of public spending influences the within and between income inequalities in Africa. Also other measures of inequalities such as consumption can be researched into.

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APPENDICES

A: List of Countries

Country	CODE	LOCATION
Tunisia	TUN	North
Mauritania	MRT	West
Mauritius	MUS	East
Guinea	GIN	West
Senegal	SEN	West
Cape Verde	CPV	West
Ghana	GHA	West
Mali	MLI	West
Ethiopia	ETH	East
Cameroon	CMR	West
Madagascar	MDG	East
Burkina Faso	BFA	West
Sao Tome and Principe	STP	Central
Niger	NER	West
Rwanda	RWA	East
Burundi	BDI	East

Source: Sikayena (2021)

B: Efficiency of Public Spending on Health

DMU	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Burkina Faso	0.568	0.491	0.552	0.511	0.500	0.569	0.579	0.483	0.541	0.525	0.439	0.448
Burundi	0.293	0.273	0.313	0.282	0.262	0.296	0.353	0.372	0.443	0.467	0.412	0.413
Cabo Verde	0.778	0.835	0.978	0.905	0.786	0.827	0.704	0.698	0.706	0.796	0.809	0.772
Cameroon	0.704	0.694	0.656	0.667	0.641	0.850	0.640	0.650	0.650	0.631	0.638	0.643
Ethiopia	0.675	0.604	0.715	0.668	0.575	0.712	0.707	0.795	0.809	0.832	0.856	0.946
Ghana	0.797	0.772	0.743	0.669	0.674	0.667	0.761	0.681	0.771	0.687	0.922	0.982
Guinea	1.000	0.955	1.000	0.984	0.976	0.785	0.856	0.874	0.644	0.539	0.597	0.780
Madagascar	0.532	0.605	0.672	0.636	0.602	0.621	0.735	0.770	0.644	0.575	0.541	0.605

Mali	1.000	0.888	0.737	0.575	0.626	0.733	0.790	0.737	0.657	0.721	0.790	0.791
Mauritania	1.000	0.925	0.872	0.840	1.000	1.000	1.000	1.000	1.000	0.834	1.000	1.000
Mauritius	0.976	1.000	0.894	0.887	0.837	0.917	1.000	0.953	0.883	0.898	0.888	0.896
Niger	0.349	0.379	0.392	0.368	0.430	0.449	0.517	0.512	0.524	0.433	0.505	0.404
Rwanda	0.325	0.332	0.365	0.373	0.370	0.388	0.393	0.491	0.485	0.516	0.501	0.518
Sao Tome and Principe	0.396	0.404	0.467	0.465	0.492	0.501	0.525	0.431	0.510	0.640	0.556	0.557
Senegal	0.840	0.944	0.918	0.846	0.811	0.780	0.779	0.757	0.757	0.763	0.786	0.815
Tunisia	1.000	0.992	1.000	0.986	0.980	0.925	0.930	0.925	0.963	0.967	1.000	1.000

Source: Sikayena (2022)

C: Efficiency of Public Spending on Education

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Burkina Faso	0.353	0.345	0.345	0.347	0.401	0.353	0.393	0.349	0.355	0.391	0.375	0.265
Burundi	0.336	0.356	0.368	0.321	0.299	0.326	0.334	0.344	0.306	0.325	0.440	0.428
Cabo Verde	0.329	0.397	0.391	0.402	0.384	0.430	0.427	0.733	0.621	0.554	0.476	0.425
Cameroon	0.635	0.574	0.686	0.588	0.609	0.680	0.719	0.696	0.740	0.731	0.764	0.624
Ethiopia	0.289	0.300	0.312	0.379	0.371	0.309	0.306	0.376	0.373	0.370	0.343	0.508
Ghana	0.322	0.319	0.316	0.343	0.325	0.231	0.243	0.430	0.433	0.444	0.444	0.548
Guinea	1.000	1.000	1.000	0.716	0.624	0.718	0.906	0.626	0.702	0.655	0.650	0.654

Madagascar	0.621	0.609	0.718	1.000	0.687	0.838	0.875	1.000	0.881	1.000	0.747	0.854
Mali	0.462	0.462	0.462	0.416	0.490	0.442	0.470	0.507	0.463	0.438	0.542	0.439
Mauritania	0.670	0.674	0.469	0.597	0.477	0.560	0.617	0.584	0.591	0.926	0.647	0.683
Mauritius	0.580	0.676	0.702	0.708	0.609	0.654	0.657	0.947	1.000	0.806	0.799	0.657
Niger	0.474	0.393	0.430	0.348	0.424	0.376	0.365	0.321	0.235	0.263	0.387	0.446
Rwanda	0.487	0.686	0.725	0.776	0.582	0.579	1.000	0.499	0.524	0.578	0.632	0.656
Sao Tome and Principe	0.466	0.316	0.356	0.188	0.206	0.229	0.306	0.332	0.537	0.541	0.406	0.425
Senegal	0.419	0.421	0.399	0.327	0.310	0.340	0.359	0.305	0.306	0.323	0.340	0.372
Tunisia	0.332	0.336	0.350	0.333	0.347	0.345	0.349	0.345	0.513	0.329	1.000	0.995

Source: Sikayena (2022)