UNIVERSITY OF CAPE COAST

DISAGGREGATED HEALTH FINANCING, GOVERNANCE AND INFANT MORTALITY IN SUB-SAHARAN AFRICA

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BY

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Thesis submitted to the Department of Economic Studies of the School of Economics, College of Humanities and Legal Studies, University of Cape Coast, in partial fulfilment of the requirements for the award of Master of Philosophy degree in Economics

MAY 2021

DECLARATION

Candidate's Declaration

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

Candidate's Signature …… Date ……

Name: Pius Gamette

Supervisors' Declaration

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

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

Name: Dr. Emmanuel Ekow Asmah

Co-Supervisor's Signature……Date ……

Name: Dr. Francis Kwaw Andoh

ABSTRACT

Despite evidence on the importance of disaggregated components of health financing (public, private and external health aid), little is known about the role governance performs in the relationship between disaggregated health financing components and infant mortality. Using panel data of 42 sub-Sahara African countries (SSA) for the period 2000-2016, this study analyses the differential effect of disaggregated components of health financing on infant mortality in SSA as well as across its sub-regional groups. The study also examines the confounding effect of governance in the relationship between disaggregated components of health financing and infant mortality. The study uses the Generalised Method of Moment (System-GMM) technique along with the Principal Component Analysis (CPA) to construct a governance index from three governance indicators (government effectiveness, control of corruption and regulatory quality). The study finds that each disaggregated component of health financing has a significant negative effect on infant mortality in SSA, albeit there exists regional disparities across SSA. The study also finds that governance has negative and significant confounding effects on the relationship between each disaggregated health-financing component and infant mortality in SSA. In terms of policy recommendations, Ministries of Health in respective SSA countries should strengthen partnership with foreign donors in the fight against infant mortality. Moreover, audit departments of Ministries of Health in respective SSA countries should strengthen regulations that guide health expenditure to have higher reduction in infant mortality level.

KEY WORDS

Disaggregated health financing

Governance

Generalised Method of Moment (System-GMM)

Infant mortality

sub-Sahara Africa (SSA)

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DEDICATION

To my late parents

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LIST OF ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
BMGF	Bill & Melinda Gates Foundation
GDP	Gross Domestic Product
GOV	Governance
HADPER	External Health aid
MOH	Ministry of Health
PBPER	Public Health expenditure
PRPER	Private Health expenditure
PwC	Price Water House Coopers
NGO	Non-Governmental Organisation
SDGs	Sustainable Development Goals
SSA	Sub Sahara Africa
SWAP	Sector Wide Approach
UNDP	United Nations Development Programme
UNICEF	United Nations International Children Education Fund
VAT	Value Added Tax
WHO	World Health Organisation
WAHO	West Africa Health Organization
WDI	World Development Indicators

CHAPTER ONE

INTRODUCTION

This chapter begins with the background to the study, followed by the statement of the problem, objectives, hypotheses, significance of the study, scope of the study, delimitations and limitations of the study, definition of terms and finally organisation of the chapter.

Background to the Study

The Sustainable Development Goals (SDGs) is a refined stage of the Millennium Development Goals (MDGs) suggesting a concerted effort to attain improved life for all across the globe. SDG 3 specifically relates to health, focusing on achieving a healthy life and promoting wellbeing for all by 2030 (WHO, 2015).Infant mortality accounts for infant deaths below one per 1000 live births (WHO, 2015). It is an integral yardstick in achieving SDG 3 (Murshed & Saadat, 2018) as it is widely acknowledged as a superior indicator of a population's level of health (Miller & Stokes, 1978). Disparities in infant mortality will reveal information about a country's overall well-being and mortality rate (Haines & Avery, 1982).

Infant mortality is unevenly distributed across national, regional and global levels. Although, there has been progress over the past three decades in infant mortality, it still persists as a major health concern. Lykens et al (2009) confirm that infants born in developing countries are 13 times more likely to experience mortality than infants in developed countries. The SSA region presents a unique perspective to the infant mortality menace because countries that rank high considering infant mortality rates are located within SSA compared to high North Africa. For example, Sierra Leone, Nigeria, Mali and

Somalia rank very high on the infant mortality index (WHO, 2019). Nwankwo (2015) opines that considerable number of SSA countries have witnessed a drop of 30% or more in infant mortality since the implementation of the Millennium Development Goals (MDGs). Moreover, sub-Sahara Africa (SSA) countries continue to have high infant mortality rates compared to their counterparts in Europe, Latin America and Asia (Kazembe et al., 2012). Becher, Muller, Jahn, Gbangou, Kynast-Wolf & Kouyate (2004) maintain that despite ongoing declines in infant mortality, infant mortality remains relatively high in the SSA region.

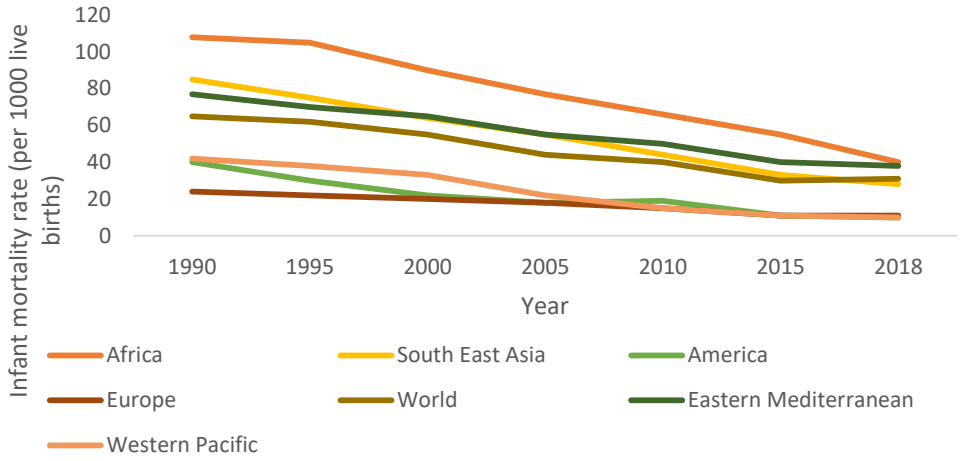

Figure 1: Trends of infant mortality rate globally and across WHO regions (1990-2018).
Source: World Development Indicators (2020)

Health financing has become an important concept in The World Health Report 2000 which established health funding as one of the four health system functions (Liaropoulos & Goranitis, 2015). Health financing, according to Kutzin (2001), is a feature of a health system that involves mobilizing, gathering, and assigning funds to meet people's health needs in the health sector, both individually and collectively. The performance of the overall health system, including the accessibility, consistency, and efficiency

of primary care, is influenced by health financing. By enhancing efficient service coverage and financial security, it encourages advances toward universal health care.

According to the WHO (2020), millions of population do not have access to services because of the prices, while many others provide low quality of service although they pay out of the pocket. Sub-Sahara Africa countries have made huge financial investments in health care provision as part of efforts to curb the high infant mortality rates to achieve SDG 3. This action is in line with the Lancet Commission's Global Health 2018 report on "Investing in Health" which acts as a guide in meeting the required amount of health investment hence affording the international community the capacity to achieve improved health outcomes (Watts et al., 2018). Health funding programs carefully developed and implemented will help to solve these problems.

Health financing has three components: these are public funding, private expenditure and external aid (health aid). Public health expenditure applies to health care spending generated by public funds. Private health expenditure connotes forward payments made by private citizens, households or organisations to health care professionals while they are using the facility. External health aid indicates foreign funds that flow from donor agencies into SSA region for the purposes of health care. Specifically, public health funding mostly emanates from taxation, budgetary allocations and social contributions. Public health funding is geared towards ensuring that the populace has access to affordable and quality healthcare. SSA countries depend on a combination of limited government finances, donor support and generally high household

contribution rates in meeting all health expenditures (Lagarde & Palmer, 2018).

Owing to a lack of a substantial tax base, government funding is significantly restricted in low-income countries. Due to the high cost of illness, a shortage of expendable income among the population, and the challenge of constructing broad, diverse insurance pools, health coverage is challenging to enforce. Almost all of Africa's practiced health insurance programs depend on government funding to stay afloat (Rhatigan Jr, 2020).

Private health expenditure serves as a complementary source of health financing in SSA region. Households use their accumulated savings, borrowed money and sold assets to cater for health expenditure. In Sub-Saharan Africa, out-of-pocket expense accounts for 44 percent of overall health spending on average (Beogo, Huang, Gagnon & Amendah, 2016). Across most low-income nations, out-of-pocket health costs (i.e. private spending that is not pre-paid as part of an insurance system) account for a considerable portion of healthcare delivery. This is particularly difficult for many people who do not have consistent sources of cash income and have limited savings. These costs also push families into misery or function as an impediment to receiving essential health care services. In low-income countries with the highest disease burdens, there has been a large rise in external support for health. In low-income countries, Development Assistance for Health (DAH) accounts for a large portion of healthcare costs, accounting for 40% of overall healthcare expenditures on average (Rhatigan Jr., 2020). DAH has grown steadily across the world, but the focus of these funds has shifted away from HIV/AIDS,

tuberculosis (TB), and malaria and toward maternal, newborn, and child health.

Studies on achieving the SDG 3 indicate that external aid (health aid) is a bridging fund that caters for the health-financing gap between private expenditure and public funding on health (Fryatt & Bhuwanee, 2017; Stenberg, 2017 & Bustreo et al. 2015). Global estimates indicate that to achieve the Sustainable Health Development Goals, an additional fund between $25 billion to $70 billion a year is needed as external aid (Kenny & Snyder, 2017). Donor funds like the Global Fund, Global Alliance for Vaccines and Immunisation (GAVI), PEPCARE, Bill & Melinda Gates Foundation (BMGF) are set up to provide medical personnel, technical assistance and medical supplies etc. to Sub Saharan Africa (Fund, 2019).

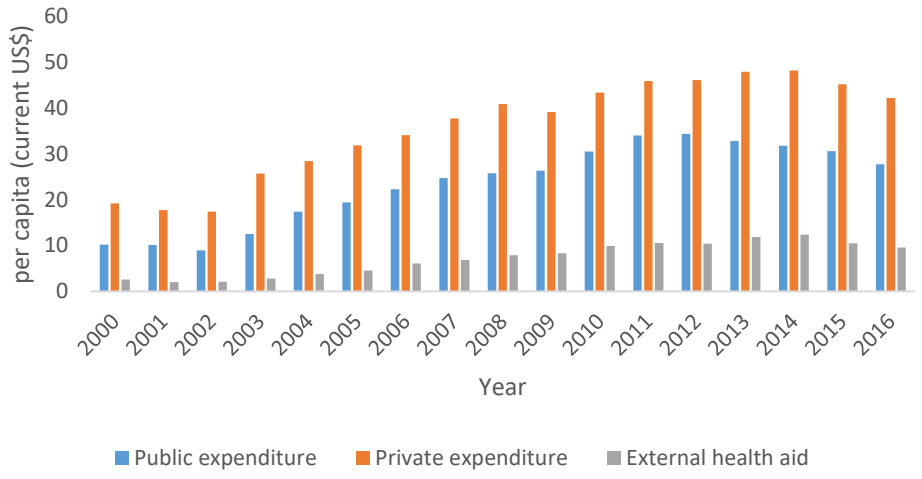

Figure 2: trends of disaggregated health financing components (public, private and external health aid) in Sub-Sahara Africa (2000-2016)
Source: Gamette (2020)

Over the last two decades, amount spent by government, private households and donor agencies keeps soaring. Among the three disaggregated health financing components, private individuals and households incur the highest health expenditure in the respective SSA countries. Specifically,

private health expenditure records the highest expenditure ($48) with the lowest health expenditure ($17) in 2014 and 2002 respectively. Public health expenditure records the lowest health expenditure ($10) in 2001 whiles the highest public health expenditure ($34) in 2002. On the contrary, external health aid amounting $12 and $2 are recorded in two different years (2014 and 2001) representing both highest and lowest expenditures. However, the various health investors in SSA countries incur different health expenses culminating in disparities in infant mortality reduction.

The amount of funds invested in the health, as measured by general public expenditure, private expenditure and external aid spending are potentially important determinants but do not guarantee a reduction in infant mortality. These financing components can yield the needed infant mortality reduction on condition of efficient utilisation. Governance serves as a key facilitator for health financing in achieving reduced infant mortality in SSA. Gisselquist (2012) indicates that governance denotes how control is exercised in managing the economic and social development tools of a nation. From the 2000s, various policy reforms have shaped governance in the respective countries in the SSA region. Based on World Bank classification, governance is measured by authority and transparency, political stability, policy efficiency and effectiveness, standard of legislation, rule of law and the prevention of corruption. These governance indexes are paramount in the effective use of health resources to curb the incidence of infant mortality.

Various studies (Kaufmann, Kraay & Mastruzzi, 2007; Rajkumar & Swaroop, 2008 & Olafsdottir et al., 2011), note that good governance and better development outcomes have strong cause-and-effect relationship. It is

therefore pertinent to assess how country level governance integrate with health financing to affect health outcomes like infant mortality in SSA. This is premised on the fact that SSA's reduced infant mortality rate though high compared to other regions and improvement in governance level are only generally gleaned from public discourse without any empirical content.

Statement of the Problem

There exist large variations in infant mortality rates between SSA and the developed world. Majority of SSA countries continue to witness infant mortality rates over 100 compared to 30 per 1000 in developed economies, despite huge financial investments in the health of the populace (Tabutin, Schoumaker & Rabenoro, 2004). Existing research on the health expenditure predictor relationship and infant mortality have examined either the effect of total health spending or other aggregated components of health spending. For example, Anyanwu and Erhijakpor (2009) examined total health expenditures and infant mortality rates in Africa. Novignon and Novignon (2012) considered both public and private expenditure on infant mortality in 44 SSA countries. Kilanko (2019), Rahman and Rahman (2018) and Dhrifi (2018) studied the impact of aggregate health funding on infant mortality. Whiles these studies contribute to knowledge, they leave external health aid as a critical component of health financing in SSA countries. Hence, policy makers and health financiers have not been properly guided in policymaking on effective health-financing component to focus in the fight against infant deaths in SSA. Therefore, it is worthwhile to provide the differential effects of all health financing components in a single study focusing on SSA.

In recent years, efficient health financing remains a global agenda. Hsiao (2007) suggests that more financial investment in health is a necessary but insufficient condition for a reduction in infant mortality. This is against the idea that health funds guided by national governance structures may have different effects. This has drawn the attention of those in both policy and academic circles to the possible role the quality of a country's governance play in the various health financing components to affect health outcomes. However, there are gaps in understanding as to whether and the extent to which governance in SSA can enhance the effectiveness of the different health financing components in reducing infant mortality. Therefore, this study seeks to fill the gap by examining the differential effects of all disaggregated health-financing components on infant mortality as well as the confounding effect of governance in the former relationship.

Purpose of the Study

The purpose of this study is to examine the effect of the disaggregated components of health financing on infant mortality and to ascertain the extent to which country level governance affects their impacts.

Research Objectives

- Estimate the differential effects of the disaggregated components of health financing on infant mortality in sub Sahara Africa (SSA).
- Analyse the comparative effect of disaggregated components of health financing on infant mortality across sub-regional groups in sub Sahara Africa (SSA).

- Examine the confounding effect of governance on the relationship between each of the disaggregated components of health financing and infant mortality in Sub Sahara Africa (SSA).

Research Hypothesis

H_0: disaggregated health financing (public, private and external health aid) has no significant effect on infant mortality in sub-Sahara Africa.

H_1: disaggregated health financing (public, private and external health aid) has significant effect on infant mortality in sub-Sahara Africa.

H_0: disaggregated health financing (public, private and external health aid) has no significant effect on infant mortality across sub-regional groups in sub-Sahara Africa.

H_1: disaggregated health financing (public, private and external health aid) has significant effect on infant mortality across sub-regional groups in sub-Sahara Africa.

H_0: governance has no significant confounding effect on the relationship between each of the disaggregated health financing components (public, private and external health aid) and infant mortality in SSA.

H_1: governance has significant confounding effect on the relationship between each of the disaggregated health financing components (public, private and external health aid) and infant mortality in SSA.

Significance of the Study

This study offers a regional perspective as the next step in the literature by establishing the effect of all disaggregated components of health financing on infant mortality in SSA. Moreover, this study will also provide indication on the effect of each disaggregated health financing component on infant

mortality across the four sub-regional groups in SSA. This is because there is growing interest in ensuring regional and sub-regional integration hence this study provides the platform in getting a thorough understanding of sub-regional differences in health financing and governance structures on reducing infant mortality in SSA. This contributes to interventions focused on solving sub-regional specific concerns on health financing, governance and infant mortality.

This study will come out with policy recommendations to help specific departments in the Ministries of Health in respective countries to institute proper governance structures in the fight against high infant mortality rates in sub Saharan Africa. Furthermore, this study will offer recommendations to Ministries of Health in respective SSA countries in their collaborative effort with donor partners in the fight against infant mortality in SSA.

Delimitation

This study is limited to health financing, governance and infant mortality in SSA. The study concentrates on only 42 selected SSA countries traversing from the period 2000 to 2016 due to data availability. The study uses secondary data from the World Bank's World Development Indicators.

Definition of Terms

This study uses some key terms which need clarification in order to understand the context in which they are being used.

Health Financing: The use of monetary backing to demonstrate that the health system can properly cover the mutual health needs of all people.

Disaggregated Health Financing: This include public health expenditure, private health expenditure and external health aid that are used in catering for the health care needs of a country's populace.

Governance: The structure by which an organization is governed and operated, as well as the processes by which its citizens are called to account.

Infant Mortality: The likelihood of a child conceived in a given year or time dying before reaching the age of one.

Organisation of the Study

This study is divided into six chapters. Chapter one presents the background of the study, problem statement, objectives of the study, hypothesis to be tested, and significance of the study, delimitation of the study, definition of key terms and organization of the study. Chapter two deals with an overview of governance in health financing in sub-Saharan Africa. Moreover, chapter three reviews related literature that is both theoretical and empirical evidence on the effect of governance and health financing mechanisms on infant mortality. Chapter four deals with the methodology that formulates empirical model and econometric estimation technique. Chapter five presents the econometric results and discussion on the results. Finally, chapter six gives summary of findings, policy implications, conclusions and recommendations of the study.

CHAPTER TWO

HEALTH FINANCING, GOVERNANCE AND INFANT MORTALITY IN SUB SAHARAN AFRICA

Introduction

This chapter focuses on the main variables of the study. Specifically, it elaborates on the trends of disaggregated health financing and infant mortality across sub regional groups in Sub Saharan Africa (SSA). In addition, the chapter discusses governance in health financing, trends of governance dimensions in SSA, drivers of health expenditure and innovative health financing in Sub Saharan Africa.

Expenditure levels of Health Financing Components in Sub Saharan Africa

Sub-Sahara Africa (SSA) countries experience diverse mechanisms in financing health within the region. Under the ambit of this study, the study focuses on three financing mechanisms (public, private and external health expenditures) measured at per capita to get better and consistent amount that governments, private households/ individuals and external donors incur in their quest to seek health care in SSA over the study.

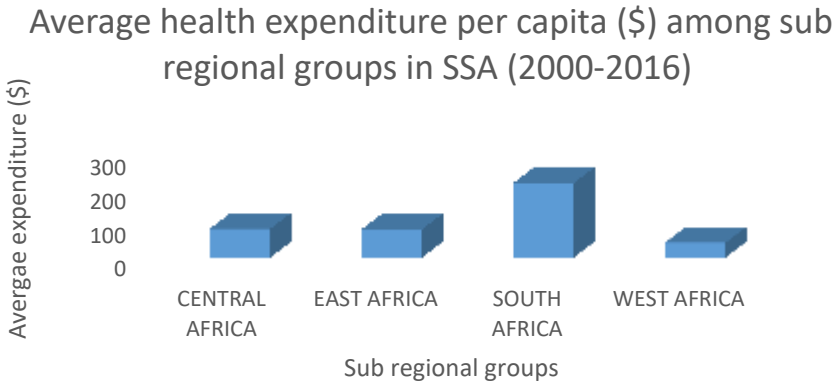

Figure 3: Average health expenditure per capita in SSA (2000 -2016)
Source: Gamette (2020)

Current health expenditure is the sum of all the expenditures incurred by the government, private individuals and external donors towards health care delivery. Among the sub regional groups in SSA, South Africa incurs the highest average expenditure over the period 2000 to 2016. Over the seventeen-year period (2000-2016), South African countries spend on average $219 on each individual who goes to seek medical care. Central Africa ranks second in terms of current health expenditure in SSA. On average, Central African countries spend $84.3 over the same period. East Africa and West Africa spend $83 and $43 on health respectively. South Africa has high health expenditure due to high medical expenses in treating infections like HIV/AIDS, pneumonia and tuberculosis in Botswana, Namibia and South Africa.

Private health expenditure

Domestic private spending includes medical insurance premiums and voucher plans, mandatory employer health spending, health expenditure by non-profit health care and out-of-pocket (OOP) expenditure on individual health products.

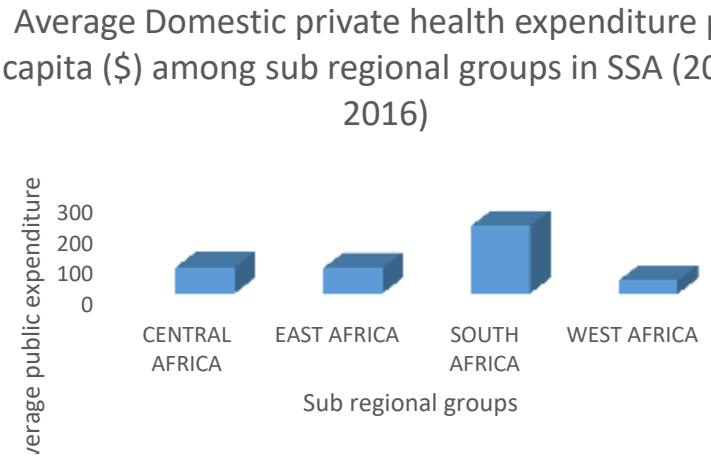

Figure 4: Average Domestic private health expenditure per capita in SSA (2000 -2016)
Source: Gamette (2020)

Figure 4 shows that average domestic private health expenditure forms a huge chunk of total health expenditure for some sub regional groups than others. Over the period (2000-2016), South Africa records the highest private individuals/ households expenditure. Private individuals/ households spend $84 on individual's health in a year. Moreover, households and private individuals in Central Africa spend $45 on any individual who seeks medical care. Over the seventeen-year period, private entities (households/ individuals) in East African countries spend the lowest amount ($14) per head in seeking health care.

Public Health expenditure

In the spirit of improving health treatment in Sub Saharan Africa, government in respective SSA countries commit many financial resources to the health sector.

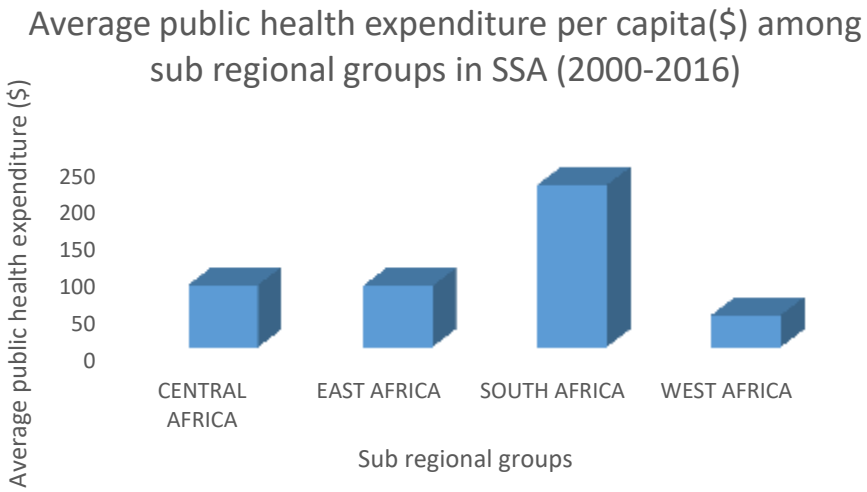

Figure 5: Average Public health expenditure per capita in SSA (2000 – 2016)
Source: Gamette (2020)

Figure 5 shows financial commitments of SSA countries towards meeting health care needs of the population. Within the study period (2000-2016), public expenditure per head in South Africa is $117 representing the

highest amount that domestic government within the sub-regional spent annually on any individual who seeks health care. Countries within the East Africa sub-region incur a cost of $59 per head indicating the sub-region with second highest average domestic public expenditure on health. Governments in Central Africa countries incur $31 per head on health. Governments in West Africa perform poorly in catering for the health care needs of the population. Domestic health expenditure is $14 per person. Despite the high disease burden of the sub region, governments within the West Africa sub–region are struggling to generate enough funds to cater the influx of new diseases like Ebola with spread in countries like Guinea and Sierra Leone.

External Health Expenditure

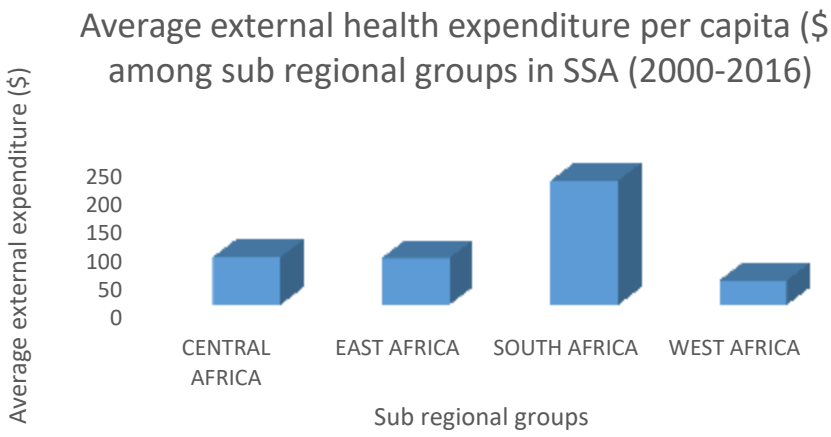

Figure 6: Average External health expenditure per capita in Sub Saharan Africa (2000 -2016)
Source: Gamette (2020)

Figure 5 indicates the amount that countries grouped into sub groups spent to cater for the health care needs per person over the study period (2000-2016). Despite the highly unpredictable nature associated with external aid and fungibility challenges, SSA sub regional groups continue to enjoy external aid flowing into the region. South Africa commits considerable external funds

to a patient's health care needs than the remaining sub regions. Countries like Bostwana, Eswatini (Swaziland) and Zambia spend large public funds on health care provision. Countries at the southern part of SSA spend on average $17.6 of external funds on individual's health representing the highest among $9.2 (East Africa), $8.1 (Central Africa) and $7 (West Africa).

Rising Health Expenditure

According to Mohd (2019), health expenditures in SSA increase on yearly basis which are mostly attributed to cost of advanced treatments and procedures in medical facilities. Hence, rising health expenses continue to diminish governments and employers' capacity to save for investment opportunities. On the other hand, households are susceptible to experiencing catastrophe financing after committing more than 25% of their household income to health care. External partners have therefore ventured into the respective SSA countries health sector to complement the investment efforts of both governments and private sector (households, individuals and companies) to generate adequate funds to cater for the health care needs of the populace.

Drivers of Rising Health Expenditure

The age structure contributes significantly to the upsurge in health costs in SSA (Oyediran, Makinde & Adelakin, 2020). A critical look at the population pyramid of most SSA countries reveals that the region has a youthful population hence majority of the medical expenses are skewed towards the youth. The most vulnerable group among the youthful population are infants who easily prone to various ailments. This vulnerable group (infants) constitute a considerable number of this youthful population. Infants

in SSA region suffer from malaria, measles, HIV/AIDS treatments and tuberculosis infections (WHO, 2019). The region also has a significant portion of the populace above 65 years (Novignon, Olakojo & Nonvignon, 2012). Healthcare spending consistently upsurges due to aging population, as they require special medical attention to keep them healthy (Zhou et al, 2020). Breyer et al (2010) indicate that increase in longevity has influence on the demand for life-prolonging medical care culminating high medical expenses.

A study on people's behaviour undertaken by Von Lengerke and John (2006), Dall et al (2007), Oldridge (2008) and Scarborough et al (2011) reveals a direct link between unhealthy way of life and healthcare expenses. Individuals who adopt unhealthy lifestyle require increasing medical services, which makes such individuals incur more cost on medical care. A study by WHO (2019) indicates that SSA countries face serious health challenges particularly high cholesterol, high blood pressure and diabetes resulting from unhealthy lifestyles at various households. This increases both government and households' expenditure in curing such diseases.

Based on Behind the Numbers 2019 report, medical technology and innovation are recurring drivers of increasing healthcare cost (PwC, 2019). New technologies enhance health outcomes and increase patients' satisfaction but tends to cost more as opposed to existing standards. Ghana and Nigeria have adopted access mobile technology to digitally record patients' information and provide a practice management and interaction platform that automates patient contact through SMS, emails and smartphone notifications. Rwanda, Ghana and Malawi have also introduced drones to distribute blood to remote areas in the respective countries (Odero et al., 2016). In 2018, Ghana

incurred an estimated cost of $12million with Zipline Company using drone technology (Ekewe, 2018). Moreover, South Africa has introduced Medici whiles Kenya has also introduced Zidi technology to improve upon health delivery to patients (Ekewe, 2018). Acquisition of the above services comes huge mobile data charges, which culminates in high medical care expenses.

Innovative Health financing in Sub Saharan Africa

Innovative financing for health denotes unconventional solicitations of formal development aid or shared public-private mechanisms that improve health care provision to the populace. Challenges surrounding health financing has generated interest in promoting access to universal health coverage via innovative financing mechanisms for the growing populace.

Sector-specific taxes

According to Bradshaw, Liao and Ma (2019), countries decide to tax specific lucrative sectors or big corporations as additional sources of revenue to cater for health expenses. In SSA, many profitable corporations operate in the oil, mining, telecommunication and the financial industries. Countries such as Angola, Nigeria, Ghana, Cote D'Ivoire and South Africa with abundant natural resources can rely on companies operating in the oil sector, mining sector, cocoa industry and telecommunication industry as alternative revenue generation spaces for supporting health delivery (Fagboyegun, 2016). However, in considering various options for taxing large corporations, policymakers need to bear in mind that they need to strike a balance between retaining investment opportunities and producing sufficient public spending capital. Nevertheless, the policy choices are extremely context dependent.

Excise taxes on harmful products

According to Jibril (2012), countries are been entreated to impose excises taxes on items that pose health risk on the populace. This is because the intake of products such as tobacco, alcohol and unhealthy foods contributes to the cost of health care for diabetes, cancers and other non-communicable diseases that impose substantial costs on health systems in the region. Taxes on these products are known as "sin taxes" which are not innovative because they already exist in most countries. Moreover, countries in the region can also look at placing high tax rates on junk foods such as candy and sucrose beverages looking at the current incidence of diabetes and pulmonary diseases across SSA.

Travel and other related levies

SSA boasts of many tourism sites that countries can rely on such sites as a way of generating revenue to support health care. Thus, countries can view this revenue generation measure as a tourism consumption tax. Specifically, governments in the region can rely on entry tax for foreign visitors into the various countries as well as get a percentage deducted from tourists exchanging money upon arrival at the various entry points. In 2008, the Gambia was able to raise an amount equal to more than 1% of total public health spending to support health delivery in the country (Stenberg et al., 2017).

Taxes on specific items

SSA countries can also rely on taxes on certain products as a means to generate proceeds for the health sector. These taxes come in the form of Value Added Tax (VAT), vehicle tax, propriety tax. Extravagance tax on items such

as private jets, ship and big cylinder vehicles comes in handy to support health care cost in the region. Moreover, an instance of a resource-raising procedure based on high occurrence dealings would be via a slight unitary charge on mobile phone use to support health care cost. Ghana introduced luxury tax for two fiscal years (2017-2019) to support health care expenditures (Mungomba, Haatongo-Masenke & Cheelo, 2020).

Infant mortality in sub Saharan Africa

Health statistics in SSA is a replication of the developmental stage that most of the economies find themselves. Most of the countries have not diversified their economies due to over reliance on primary materials culminating in low returns for individuals and the economy as a whole. Most households have to struggle with high medical user fees pushing most households into financial catastrophe. The demography of SSA is such that infant mortality continues to be a disheartening challenge for health practitioners. However, Lutambi et al (2010) opines that there are geographical variations in the spread of infant mortality among SSA countries.

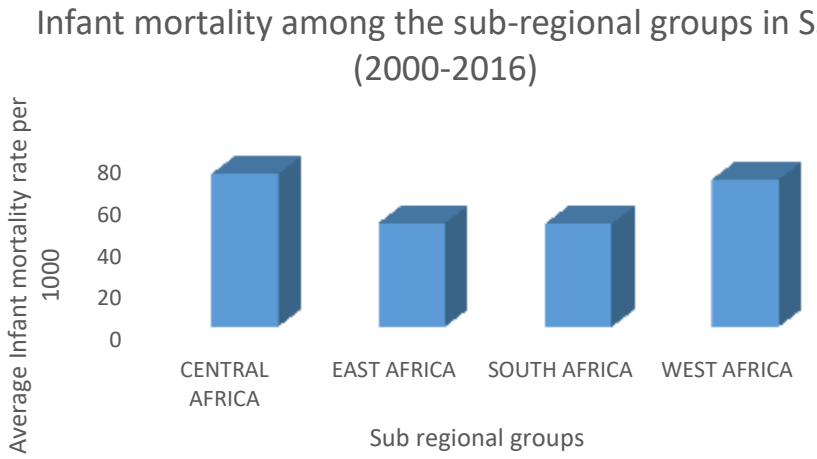

Figure 7: Trends in Infant mortality rate in SSA (2000 -2016)
Source: Gamette (2020)

Figure 7 indicates that countries in Central Africa experience the highest infant mortality rate among the four sub-regional groups. Central Africa Republic, Chad and Cameroon are politically unstable due to civil wars and militant attacks. Vulnerable groups like infants suffer the most hence the high infant mortality rate in Central Africa. West Africa follows closely as the next sub region with the second highest infant mortality rate. Considering the study period, West Africa experience upsurge in Ebola infection, high incidence of HIV/AIDS virus, malaria and tuberculosis cases. Guinea and Sierra Leone experience high mortality rate among the populace due to Ebola spread from 2014 to 2016 (WAHO, 2019). Over the same period, countries in East Africa witness an average infant mortality rate of approximately 50 per 1000 live births. Burundi contributes much to the sub-region's infant mortality rate over the seventeen-year period (2000-2016). South Africa sub-region experience the lowest infant mortality rate from 2000 to 2016. Despite South Africa and Botswana ranking high on global HIV/AIDS prevalence rate, South Africa sub-region has the lowest (44) average infant mortality rates. This is contrary to the reality at the national level because infants are sexually inactive compared to their adults counterparts who are sexually active.

Trends of Governance Dimensions in Sub-Sahara Africa

The World Health Report popularized the concept of Governance in health in the early 2000s. Subsequent years have shown that issue of governance has gained global attention especially within the circles of quality healthcare delivery. The World Bank (2010) recognises governance as an indigenous way of handling countries and institutions involving the process through which rules are formulated. Based on World Bank's classification,

governance is measured by political steadiness and nonexistence of violence, accountability, rule of law, government effectiveness, control of corruption, regulatory quality. Shen (2011) also indicates governance as the procedures involved in decision-making and the practices through which rules and regulations are formulated and implemented. Siddiqi et al (2009) developed another interesting governance indicator in health system administration. These principles include Participation, rule of law, openness, sensitivity, consensus-orientation, justice, quality and effectiveness, accountability and strategic vision. On the contrary, developed by Lewis and Pettersson (2009), another measurement of governance indicators for health systems into five thematic areas: human resources, informal payments, institutions, institutional providers and budget management. These thematic areas are subject to thorough investigation to acquire in-depth understanding of the existing health system.

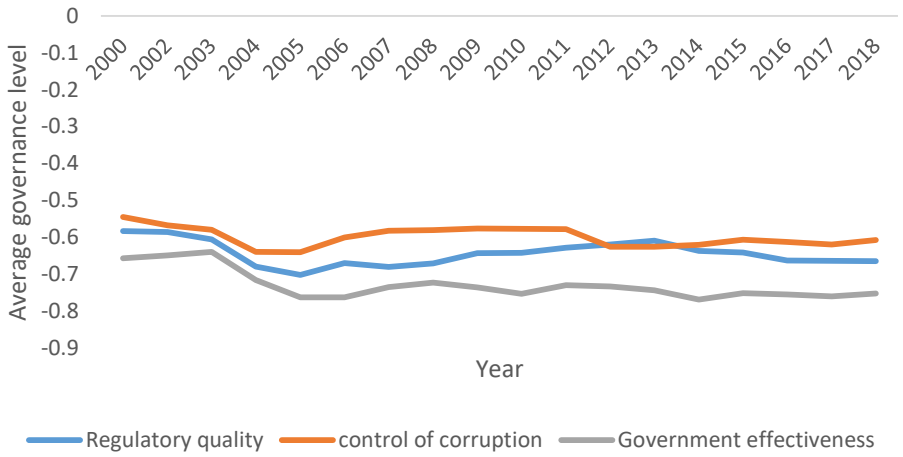

Figure 8: Trends of governance dimensions in Sub-Sahara Africa (2000-2018)
Source: Gamette (2020)

Within a span of eighteen years (2000-2018), majority of SSA countries record negative governance indicators (government effectiveness,

control of corruption and regulatory quality). From figure 8, government effectiveness is the poorest governance gauge among the three governance measures. Efforts to control corruption was best from the year 2000 till 2013 where control of corruption intersects regulatory quality. After 2013, control of corruption begins to improve again. In two different years, 2013 and 2015, both control of corruption and regulatory quality records similar estimate in SSA countries.

Governance in Health financing Mechanisms

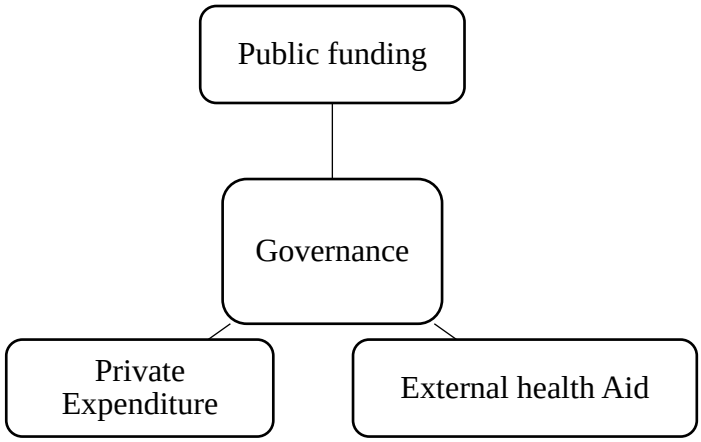

Figure 9: The role of Quality Governance in health financing
Source: Sirag, Nor, Abdullah and Abd Ghani (2017).

Governance plays a pivotal role in the various health care financing mechanisms that exists in the region (Sirag et al, 2017). Components of governance that facilitates existing three-health financing are government effectiveness, regulatory quality and the level of corruption. Government effectiveness indicates government's capacity to make better plans such as committing certain proportion of the Gross Domestic Products (GDP) to health. Governments in the region are making efforts to commit 15% of GDP to health (Tandon & Cashin, 2010). Regulatory measures enable private individuals to engage in any business venture with the intent of generating

enough funds that helps households to seek health care. The level of corruption is also key in using external health aid in the sub-region. Corrupt practices involves diversion of funds into other ventures and embezzlement of funds meant for child health. When there is low incidence of corruption, then external health aid can be effective in achieving improved health status.

Chapter Summary

The chapter presents trends of health financing mechanisms (public, private and external health aid) and infant mortality variables in Sub Saharan Africa (SSA) from 2000 to 2016 which is the study period. The chapter also delves into the trend of governance dimension in SSA, governance in health financing, drivers of rising health expenditure and innovative health financing in Sub Saharan Africa (SSA). From the trends of statistics, the huge variation in health financing mechanisms and infant mortality across sub-regional groups is confirmed from the different stages of economic development within SSA.

CHAPTER THREE

REVIEW OF LITERATURE

Introduction

This chapter provides the theoretical foundation of this study. This section provides a review on empirical works detailing the connection between health financing and governance on infant mortality in Sub Saharan Africa. This chapter also explicates current literature on the issue and consequently explain the significance and contribution of this research in bridging the existing gaps.

Theoretical Approaches to Health Financing

This segment introduces a review of basic theories underlining health financing and governance in relation to infant mortality as an essential health outcome in Sub Saharan Africa.

Theory of Production

The conventional theory of production indicates how inputs are mixed together to produce a certain level of output (Cobb & Douglas, 1928). Production inputs also known as factors of production are land, labour, capital and entrepreneurship. These inputs can either be fixed or variable inputs depending on the production time period (market time period, short run period, long run and very long run time period). However, the theory of production is fixated on two factors of production (labour and capital) which can vary in the production process. Production theory is expressed in a production function where quantities of labour (L) mixes with quantities of capital (K) and technology (A) to produce a certain level of output (Q). Mathematically, $Q = f(L, K, A)$ where L is quantity of labour, K is the quantity

of capital and A is the level of technology. The technology facilitates efficient mixing of the two inputs (labour and capital). In order to know the expenditure incurred in producing Q, labour (L) is given wages (w) and capital (K) is given interest rate (r). Hence, the expenditure is production can be derived as $TE = f(L * w, K * r, A)$ where TE is the total expenditure incurred in producing quantity (Q), $L * w$ is the expenditure on labour, $K * r$ is the expenditure on capital.

In the same vein, this study conceptualizes frameworks of conventional production function and Grossman's health production model to explain health investments (Grossman, 1972). Grossman builds up a model that indicates that health output is a function of health care inputs. Individuals are seen as producer of health who invest in health to enhance their chance of survival. The inputs are recognized as investments made in the health system which are categorized into public expenditure, private expenditure, external expenditure and governance. Governance (GOV) acts as intervening factor that make health expenditure efficient in achieving improved health outcomes. The expenditure made in achieving a particular health outcome is total health expenditure (THE). At the individual expenditure levels, PP is the total population, amount incurred by the public is (PB*PP), private expenditure is (PR*PP) and amount of external funds devoted to health care is (HAD*PP). Mathematically, $THE = f(PB * PP, PR * PP, HAD * PP, GOV)$ where THE is the total health expenditure, $PB * PP$ is the aggregate public health expenditure on the population, $PR * PP$ is the total private health incurred by households, $HAD * PP$ is the total external aid investment in the population's health, GOV is the governance level.

Healthcare expenditure is considered a primary determinant of health care usage. An improvement in acquiring healthcare is linked with improved health and advances levels of healthcare use (Mackenbach, Valverde, Artnik, Bopp, Brønnum-Hansen, Deboosere & Nusselder, 2018). This study focuses on the theoretical arguments pushed to support the production and investment in healthcare. The challenge in determining the effect of health expenditure on infant mortality nevertheless is appropriate within the theory of production because governments, households (parents) and individuals invest in their children's health however under a budget constraint.

In understanding the link between disaggregated health financing, governance and infant mortality, this study adopts the Production theory and Grossman's health production model to analyse the phenomenon.

Gross Domestic Product (GDP) – Lead- Health Theory

A significant theory that provides a theoretical basis for health financing is the Gross Domestic Product (GDP lead Health theory. Hansen and King (1996) opined that aggregate health spending has a significant and direct influence on health performance depends on Gross Domestic Product and economic growth. The GDP lead health theory illustrates the effects of GDP and development on major health variables through choosing GDP as a primary and sole reliable explanatory predictor for health outcomes and changes in health financing disparities (Hartwig, 2008).

In a more concrete form, this theory tries to elucidate some fundamental theories like "income-health gradient" hypothesis which predicts that improved health care is a basic human need which is also essential to human survival and has a direct effect on welfare. GDP at the national level is

synonymous with income levels at both the micro and macro analysis. At the macro level, the accrual of increased income and high GDP growth at both the government and private sectors help allocate increased expenditure on health care services. With a surge in health treatment cost, there is the expectation of improved health outcomes and health indicators such as morbidity, mortality and other health outcomes within the various communities in a country.

Figure 10 below gives a vivid pictorial outlook of the probable connection between the health of an individual as a direct function of income level. Increased income level results in improved health at low threshold of income and marginal progress occur at increased income levels. Increased income levels could improve health levels via two transmission mechanisms. First, increased expenditure on health care results in movement along the income-health curve. Secondly, increased expenditures on ascertaining and adopting enhanced health care technologies can shift the income-health curve up.

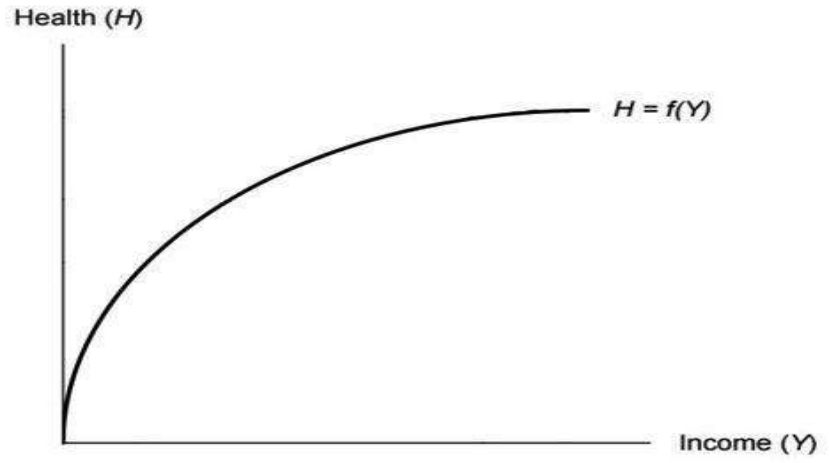

Figure 10: Income-Health relationship
Source: Hansen and King (1996)

In this way, the notion of "Wealthier is Healthier" suggests that economic growth (measured by higher GDP) produces additional

opportunities that enable economies to develop and become more effective in their health financing arrangement. In other terms, financial resource is a critical and essential part of improved health in both the public and private medical facilities. Economies with wealthier populations are paying more money to combat the illness they are dying from, contributing to an enhancement in the rate of good health and life expectancy.

Two Gap theory

Harold and Domar research in the 1930s and 1940s opened up the issue of interrogating the efficacy of developed countries' foreign assistance. The two-gap theory postulates that capital resources flow into developing countries to perform specific health functions. This is against the backdrop that there exist savings gap between the domestic resource mobilization and investment levels (health expenditure) in developing countries. Therefore, saving gap is regarded as the primary health spending issue in developing countries (Rotarou & Ueta, 2009).

The capital resources come in the form of health aid to fill the saving gap that exist between government funding and private expenditure on health. Chenery & Strout (1966) suggested the “two gap” theory as a support for the Harold-Domar model of growth. Chenery and Strout (1966) have introduced a third difference in human capital that flows to developing economies. This is due to the scarcity of managerial skills and technological expertise to aid in efficient health delivery. However, the prime focus of this study is on the two-gap theory (capital resources- external health aid) in health financing in sub Saharan Africa (SSA). However, criticism against the two-gap theory (Harold Domar, Schenery and Strout, 1966) is that all the researchers considered only

capital resources as the sole imperative means of bridging inefficiencies in health care.

Good Governance Theory

Keraro (2014) posits that the good governance theory as popularized by the United Nations Council in the 1990s stressed on strong public sector administration, accountability, exchange of information and a constitutional framework for development. This theory focuses on government's or public institutions' actions undertaken to enhance productive levels of an institution (as a component of sub-systems) by increasing its efficiency and legality. In this regard, good governance signals a solid foundation for administering structures, public involvement, rules and measures that help public institutions to fulfil their mandate in delivering quality services. This study gains strength from the good governance theory as it looks at how public health facilities are reinforced through effective government policies, efficient regulatory measures and control of corruption. These measures are geared towards ensuring efficient health delivery to infants in SSA.

Empirical Review of Health Financing and Infant Mortality

This section considers parallel researches undertaken by other researchers on the research problem. The importance of reviewing similar works is to assemble in-depth information on the topic under study to create ample opportunities for analysing the data.

Public and Private Health Expenditure on Infant Mortality

In a study from 111 transition countries, Baldacci, Guin-Siu and Mello (2002) confirmed the assertion that public health spending effectively improves health status. Moreover, Gupta, Verhoeven and Tiongson (2003)

identified public health expenditure as a key contributing factor influencing health status. After controlling for consumption level and literacy levels, estimate results are obtained. In line with finding the effectiveness of public expenditure, Issa and Ouattara (2005) established that the cost of healthcare decreases infant mortality. Nonetheless, expenditure on public health was only successful in reducing child mortality at a modest stage of growth. Higher rate of growth provided private health spending to reduce child mortality effectively.

Again, Gottret and Scieber (2006) summarized similar results from 113 nations showing that spending on public health is essential to stimulating health status in low- and middle-income countries. In a panel data study involving 47 African countries between 1999 and 2004, Anyanwu and Erhijakpor (2009) adopted a fixed-effect model and established that health spending was a significant factor in deciding health outcomes, culminating in a 10 percent rise in total health care expenditure per capita resulting in 21 percent infant mortality rates, respectively. Using fixed and random effect to evaluate a panel data from 1995 to 2010 covering 44 countries in Sub-Saharan Africa (SSA), Novignon and Novignon (2012) found that that spending on health care serves as a major step towards achieving the MDGs.

Boachie and Ramu (2016) employed Ordinary Least Squares (OLS) and Newey-West regression techniques to examine the relationship between public expenditure and health status (infant mortality) in Ghana. The analysis used annual data from 1990 to 2012 on child death rate, real per capita income, education standards, and female employment rate. The study found that both public health expenditure and literacy/education reduces infant

mortality in Ghana. However, their study did not address the problem of endogeneity which accompanies infant mortality which could lead to bias estimates. Moreover, the study did not consider environmental factors like sanitation, pollution and water facilities as key factor that could affect infant mortality. The study also had a limited scope in looking at only public health expenditure.

On the contrary, other studies recognised that public spending had little or no impact on health outcome particularly infant death. In effect, such studies found out that public health spending was ineffectual in reducing infant mortality. For instance, Filmer and Pretchett (1997) offered suggestions to indicate that although spending on health care affects infant mortality, it is not a major driving force of this child's health. The research thus centered on major health outcome factors rather than expenditure on health care and established variables such as employment, technological progress, income and differences in culture. Burnside and Dollar (1998) also show no significant connection between health care spending and variation in infant mortality in countries with low incomes.

Berger and Messer (2001) and World Bank (2004) established that spending on communal health is unsuccessful in improving the health status. In addition, these researches indicate that spending on public health performs little to no influence in enhancing health outcome. In other circles, Compa-Keyeke et al. (2013) found that spending on public health has an inverse impact on child mortality in Ghana but is negligible after regulation of per capita income, health insurance and physician numbers.

All these studies are discerning but concentrate on health financing (public and private expenditures) on infant mortality without addressing the critical roles of policies and quality governance. Moreover, these studies did not consider external health aid as an important constituent of total health expenditure capable of reducing infant mortality. Moreover, neglect of governance in facilitating health care financing creates a huge gap that needs thorough investigation especially within SSA jurisdictions. This is against the backdrop that more investment in health is a required condition but not an adequate one to child mortality (Hsiao, 2007).

External Health aid and Infant Mortality

Masud and Yontcheva (2005) examined the impact of foreign assistance on poverty as calculated by infant mortality and illiteracy rates using panel data from 58 countries from 1990 to 2001. The study found that aid fails to minimize infant mortality but rather minimizes government spending on health and education. There were issues of heterogeneity of channels through which the donor disburses health aid in developing countries.

Furthermore, studies (Collier and Dollar, 2001; Gebhard et. al, 2008) suggested that fungibility performs a significant role in shaping the milled effect of development assistance in WHO countries. Mishra and Newhouse (2009) used a dynamic modelling framework and System-GMM estimation to quantify the effects of health aid on infant mortality between 1973 and 2004. The outcomes of the study confirmed that foreign health aid is critical for reducing child mortality in WHO countries across the globe. The study considered previous infant mortality rate as having impact on current infant

mortality rate however, absence of tangible dynamics between humanitarian assistance and development. Hence, results from such study provide room for biased estimate.

In contrast to the above studies, sector-specific aid researchers that focused on quasi-exclusive health aid stressed on no or little impact of health aid. Specifically, Williamson (2008) found that health assistance had little effect on high, medium and low-income child mortality sampling economies from 1973 to 2003. Her static analysis dealt with suspected endogeneity problem using linear two-step least squares (2SLS) estimation and settled on the decision that health aid is an ineffective human development tool.

Studies (Drabo and Ebeke, 2011, Mishra and Newhouse, 2009; Williamson, 2008; Masud and Yontcheva, 2005) focused on partial analysis of health financing (external health aid) as well as ignored governance as a moderating factor between external aid and infant mortality. Moreover, addressing endogeneity problem is the least of aims of these studies. This study fills the lacuna by analysing the effect of health financing (public, private and external health aid) being intervened by governance on infant mortality in SSA.

Health financing and Governance on Infant Mortality

Lazarova and Mosca (2008) performed a regression analysis on a sample of 112 states based on two indices. Their focus was based on two indices (Gini index and Governance index) and interrogated which is an enhanced indicator to determine aggregate health capital. The research also examined the presence of a brink outcome in terms of both absolute income and governance quality. They discovered that governance index is a better

indicator for aggregate health capital compared to the Gini index. This is because governance matters in aggregate health capital formation. This work is very important because it is serves as a point of deviating from Rodgers (1979) on the absolute and relative income hypotheses. However, their study has a limited scope as well as ignores the effect of governance index on any health outcome.

Farag et al. (2013) inspected the association between country outlay on health and infant and child transience using data from 133 low- and middle-income countries in 1995, 2000, 2005 and 2006. The researchers calculated the influence of health expenditure on both child mortality and under-five mortality using a fixed-effect estimation approach. Public spending on health also has a major impact on plummeting infant and child transience, and the extent of the coefficient hang on the degree of policy efficiency achieved by the nation, suggesting that public efficiency improves health expenditure efficiency. In a related report, Lazarova and Mosca (2008) attempted to explore the impact of government efficiency on health capital. Lazarova and Mosca (2008) found evidence of a threshold effect under which government effectiveness in order to determine health outcomes is not significant.

In an experimental study on the role of governance in public spending on under-five transience and life expectancy in sub-Sahara Africa (SSA), O'Hare and Makuta (2015) identified that quality governance mediates the association between public spending and health outcomes (under-five mortality and life expectancy). This study involved a two-stage least square regression technique for panel data from 43 SSA countries during 1996–2011. They calculated the health and quality of governance effects of public

spending under five mortality and life expectancy, regulating per capita GDP, and other socio-economic factors. The higher the level of governance efficiency the greater the effect on health outcomes and vice versa.

All these studies are insightful though they concentrate on only government effectiveness as the only governance indicator in making public spending effective in achieving improved health outcomes hence predisposed to biased estimates.

Lazarova (2006) using a sample of 112 countries analysed the effect of governance on infant mortality. Under this study, Lazarova (2006) was also interested in finding the relative effect of governance indicator or relative income on infant mortality in both developed and developing countries. She used regression method to find out the impact on infant mortality worldwide of governance metrics such as policy efficiency, regulatory consistency, rule of law and level of corruption. The study concluded that there were no substantially different governance metrics between the mortality rate for female and male infants. The study failed to recognise the key role that health financing plays in reducing infant mortality. Moreover, the study was silent on the path through which governance influences socioeconomic factors as well as how governance can be improved.

According to Sirag et al (2017), health financing (public and private spending) is effective in the presence of governance indicator. By utilizing 177 developed and developing countries, Sirag et al (2017) adopted the System Generalised Method of Moment (System-GMM) to analyse the effect of government effectiveness and corruption on health financing. The findings revealed that funding for public and private health is not in the same course.

Moreover, GDP per capita and overall government spending were key factors impacting health funding in technologically advanced and emerging countries alike. International aid tends to diminish funding for public health, particularly if it is provided by a country with a low level of governance. This study was impressive and insightful however was silent on the consequence of governance indicator and health financing on any health outcome particularly infant mortality rate.

A topical study by Lin et al (2014) on the ecological relationship between governance and child morality also considered factors like urbanization, economic development and infection control. Lin et al (2014) used a semiparametric generalized mixed additive model to examine the relation between governance indicators (voice and accountability expectations, political stability and absence of abuse, policy effectiveness, regulatory efficiency, rule of law and corruption control) and 149 countries ' national under-5 mortality rates between 1996 and 2010. It was discovered that the search for better governance of a country is as significant as improvements in production and control of diseases.

This study concentrates on a differential effect analysis of disaggregated health financing components and governance from a regional perspective instead of a global perspective. Sub-Sahara Africa has idiosyncratic health problems and as such the need for such specificity. Most health financing studies have not brought out the needed results hence the need to delve deep into the confounding effect of disaggregated health financing and governance issues in SSA region.

Research Gaps

An appraisal of the experiential literature has highlighted the effects of both public and private on infant mortality from both developed and developing countries. However, given the individual country's target in reducing infant deaths in SSA countries, it is unclear why most studies have failed to consider external health aid as a critical component of health financing. The evidence is that empirical studies done on health financing have concentrated on both total or public and private health financing and their effects on infant mortality in SSA. Moreover, considering all disaggregated health-financing components in a single study based on SSA countries is particularly rare as there could be differences in the effect of each disaggregated health-financing component on infant mortality. Studies (Novignon & Novignon, 2012; Anyanwu & Erhijakpor, 2009) did not examine the effect of external health together with both public and private health expenditures on infant mortality in SSA. In addition, studies (Kilanko, 2019; Rahman & Rahman, 2018 & Dhrifi, 2018) in SSA engrossed on the impact of aggregate health funding on infant mortality. A gap therefore exists for a study that investigates the differential effects of all disaggregated health-financing components on infant mortality in SSA as well as its sub-regional groups and also incorporates governance in the analysis to inspect the confounding effect of governance on the relationship between disaggregated health financing and infant mortality in SSA countries.

Conceptual Framework

This study is built on an adapted model from the Mosley and Chen (1984) analytical framework for analysing infant survival. Mosley and Chen's

framework considers both biological and social sciences elements therefore portrays unified social and biological variables into an analytical framework seeking to explain infant mortality. Their framework also incorporated socio-economic variables acting as key determinants that function within the context of a common biological and immediate mechanism to effect infant mortality (Mosley & Chen, 1984).

This study adapts the Mosley and Chen (1984) framework by introducing both health financing and governance indicators in the model. The objective of the framework is to fill the void created in the literature between the medical and social sciences. Traditionally, social scientist have concentrated on studying the connection between socio-economic variables and infant mortality however this study will fill the gap by considering health financing mechanisms, governance indicators and socio-economic elements in explaining infant mortality in sub-Sahara Africa.

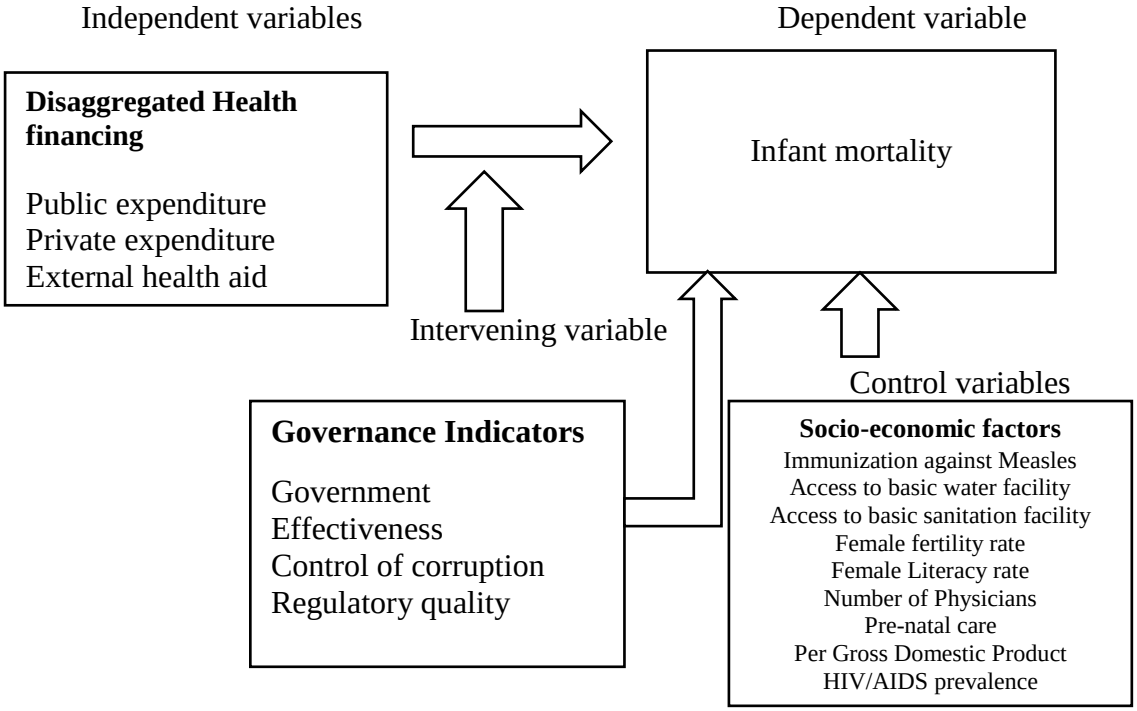

Figure 11: Governance indicators intervening the relationship between health financing and infant mortality
Source: Adapted from Mosley and Chen (1984)

The independent variables are health financing and socio-economic variables. Health financing is represented by three mechanisms public expenditure, private expenditure and external health aid. On the contrary, the most important socio-economic factors included in the study are Gross Domestic Product per capita, total population, female literacy rate, HIV/AIDS prevalence among the population, improved water facility, improved sanitation facility, immunization, pre-natal care and number of physicians available in health facilities.

Governance indicators are the intervening variables that link the independent variables (health financing and socioeconomic variables) and dependent variable (infant mortality). Governance indicators were expressed in three measures- government effectiveness, control of corruption and regulatory quality. These governance indicators were selected based on their direct effect on a health system. The governance indicators serve as fuel that facilitate efficient health financing to achieve reduction in infant mortality.

This study considered infant death as the dependent variable. As shown in figure 8, this is the threat of infant death. The likelihood of infant mortality concerning birth and first birthday (0-11 months) is known as the risk of infant mortality. Infant mortality can be affected by disaggregated health funding as well as socio-economic characteristics at child, domestic and communal level. The variables at the different rates of service mediate to affect the risks of infant mortality through quality of governance. The conceptual framework was included to show a pictorial outlook of what the study intends to achieve.

Chapter Summary

In conclusion, from the empirical studies coupled with theoretical and conceptual perspectives discussed, health financing and governance can serve as potential channels for reducing infant mortality in sub-Sahara Africa (SSA). This notwithstanding, studies on health financing and governance on infant mortality did not consider the issue of endogeneity associated with infant mortality. To fill these gaps, this current study distinct itself by examining the effect of disaggregated health financing on infant mortality in SSA as well as across SSA's sub-regions. Moreover, this study interrogates the confounding effect of governance on the relationship between disaggregated health financing and infant mortality in SSA using the System Generalised Method of Moments (System-GMM) to deal with the endogeneity problem.

CHAPTER FOUR

RESEARCH METHODS

Introduction

This chapter's main purpose is to present the appropriate methodological framework for conducting the research study. Methods and tools used in the study are the issues that come under this section. The detailed form of the model's theoretical and empirical description, model variables, data types and sources, estimation techniques and data analysis tools are clearly presented.

Research Design

In accordance with the study's objectives, the quantitative research approach using the explanatory design to investigate the effect of disaggregated components of health financing (independent variables) and governance (intervening variable) on infant mortality (dependent variable) in sub-Sahara Africa. In terms of reproducibility, transparency, and validity of the findings, quantitative research design has several advantages over qualitative research design. As a result, the analysis uses a quantitative research design to avoid relying on personal perceptions, interests, insights, or predispositions in order to maintain objectivity in the study and the conclusions drawn.

Quantitative research designs are expressed in either descriptive, where items under study are usually measured once or experimental, where subjects measured at prior and post treatment levels. This study finds its bearing in the context and assumptions of the positivists' philosophy, which supports the application of quantitative methodology. Moreover, the study seeks to

examine the effect of disaggregated components of health financing and governance on infant mortality in sub Saharan Africa.

Specification of Empirical Model

In research work, there are two main known models used for analysis: time series and cross-sectional models. The aforementioned models are based on the characteristics of each data collected (either time series or cross sectional). This study focuses on sub-Sahara Africa countries over a period of time hence a panel data is developed. Adam and Owusu (2017) admits that a panel data pools the characteristics of both cross-sectional data and time series data. In the context of this discussion, when a study concentrates on using data from more than a unit over a period then a panel data is preferred. This study therefore looks at many units (sub-Sahara African countries) and time series data from 2000 to 2016 of each unit, thus, panel model is employed. The study considers the period (2000-2016) due to one of the main variables (external health aid) which was officially recorded from 2000 to 2016 during this study.

This study adopts Arellano and Bond (1991) model specification of Generalised Method of Moment (System-GMM) as well as follows the recommendation of Agbloyor et al. (2014) and Wooldridge (2001) in using System-GMM. The System-GMM presents the opportunity to introduce lag of the dependent variable in the model. This specification is consistent with empirical study that infant mortality is a continuous and dynamic variable therefore previous infant mortality rates may influence future infant mortality rates (Mishra & Newhouse, 2009). Moreover, the System- GMM caters for endogeneity problems in a model. The model specification follows as

$$Y_{it} = a_i + Y_{it-1} + BX_{it} + \varepsilon_{it} \quad (1)$$

$$e_{it} = a_i + \varepsilon_{it} \quad (2)$$

Where i refers to the country (i = 1, 2, 3,..., 42); t refers to time period from (2000 to 2016) (t = 1, 2, 3, ..., 17) where Y_{it} is the dependent variable, Y_{it-1} is the lag of the dependent variable; a_i is the intercept, X_{it} is the vector of independent variables (regressors, control variables and intervening variables), ε_{it} is the error term assumed to be serially uncorrelated.

$$INF = f(HF, GOV, Z) \quad (3)$$

Where INF is the infant mortality rate, HF is disaggregated health-financing mechanisms, GOV is the governance index (composite) and Z is the socio-economic factors.

$$\text{Infant Mortlaity} = f(\text{Disaggregate component of health financing, Governance, Socio} - \text{economic factor}) \quad (4)$$

Expanding the socioeconomic factors yields:

$$INF = f[(PBPER, PRPER, HADPER), (GOV), IMM, IWS, ISF, FERT, FLT, NPYS, PRN, PGDP, HIVAIDS] \quad (5)$$

$$\text{Also, } HF = (PBPER, PRPER, HADPER) \quad (6)$$

Where INF is the infant mortality rate, HF is disaggregated components of health financing comprising of domestic public health expenditure per capita (PBPER), domestic private health expenditure per capita (PRPER) and external aid health expenditure per capita (HADPER), Also, IMM is the percentage of children aged 12-23 months who have undergone measles immunization while IWS is the percentage of the population with at least basic water facility. Furthermore, ISF is the percentage of the population with at least basic sanitation facility, FERT is the fertility/ number of children born to a female, FLT is the female literacy rate,

NPYS is the number of physicians and PRN is the percentage of pregnant women who receive pre-natal care, PGDP is the Gross Domestic Product per capita. Finally, HVA is the prevalence of HIV/AIDS among infants aged 0-14 years used as a proxy for prevalence of HIV/AIDS among infant aged less than 1 year and GOV is the governance index (aggregate of government effectiveness (GVT), corruption (CRPT) and regulatory quality (RQ).

Based on Arellano and Bond (1991) specification of system-GMM, the lag of the dependent variable influences the dependent variable. In this study, the lagged infant mortality rate influences the current infant mortality rate in the model specification.

The regression models are specified based on the earlier three objectives as follows:

Differential effect of disaggregated components of health financing on infant mortality in SSA

$$INF_{it} = \alpha_i + \beta_1 INF_{it-1} + \beta_2 PBPER_{it} + \beta_3 PRPER_{it} + \beta_4 HADPER_{it} + \beta_5 IMM_{it} + \beta_6 IWS_{it} + \beta_7 ISF_{it} + \beta_8 FERT_{it} + \beta_9 FLT_{it} + \beta_{10} NPYS_{it} + \beta_{11} PRN_{it} + \beta_{12} logPGDP_{it} + \beta_{13} HIVAIDS_{it} + e_{it} \quad (7)$$

Equation 7 looks at the relative effect of disaggregated components of health financing (public expenditure, private expenditure and health aid) on infant mortality in SSA.

Comparative effect of disaggregated components of health financing on infant mortality across sub-regional groups in SSA

This study conducts a comparative effect analysis based on disaggregated components of health financing across SSA sub regional groups

in order to assess how disparities in health financing components among SSA sub regions contribute to reduction in infant mortality rates.

$$INF_{zit} = \alpha_{zi} + \beta_1 INF_{zit-1} + \beta_2 PBPER_{zit} + \beta_3 PRPER_{zit} + \beta_4 HADPER_{zit} + \beta_5 IMM_{zit} + \beta_6 IWS_{zit} + \beta_7 ISF_{zit} + \beta_8 FERT_{zit} + \beta_9 FLT_{zit} + \beta_{10} NPYS_{zit} + \beta_{11} PRN_{zit} + \beta_{12} logPGDP_{zit} + \beta_{13} HIVAIDS_{zit} + e_{zit} \quad (8)$$

Equation 8 further looks at the comparative effect of disaggregated components of health financing on infant mortality across sub-regional groups in SSA. Here, the study divides SSA countries into sub groups based on their geographical location and assess the effect of disaggregated components of health on infant mortality across the varied sub regional groupings.

Confounding effect of governance and disaggregated health expenditure on infant mortality in SSA.

In considering the confounding effect, the study looks at both moderating and mediating effects of governance in the relationship between disaggregated health financing components and infant mortality in SSA.

Moderating Effect of Governance

$$INF_{it} = \alpha_i + \beta_1 INF_{it-1} + \beta_2 PBPER_{it} + \beta_3 PRPER_{it} + \beta_4 HADPER_{it} + \beta_5 GOV_{it} + \beta_6 IMM_{it} + \beta_7 IWS_{it} + \beta_8 ISF_{it} + \beta_9 FERT_{it} + \beta_{10} FLT_{it} + \beta_{11} NPYS_{it} + \beta_{12} PRN_{it} + \beta_{13} logPGDP_{it} + \beta_{14} HIVAIDS_{it} + e_{it} \quad (9)$$

Mediating Effect of Governance

Public Health Expenditure and Governance Index

$$INF_{it} = \alpha_i + \beta_1 INF_{it-1} + \beta_2 PBPER_{it} + \beta_3 PRPER_{it} + \beta_4 HADPER_{it} + \beta_5 GOV_{it} + \beta_6 PBPER * GOV_{it} + \beta_7 IMM_{it} + \beta_8 IWS_{it} + \beta_9 ISF_{it} + \beta_{10} FERT_{it} + \beta_{11} FLT_{it} + \beta_{12} NPYS_{it} + \beta_{13} PRN_{it} + \beta_{14} logPGDP_{it} + \beta_{15} HIVAIDS_{it} + e_{it} \quad (10)$$

Private health financing and Governance Index

$$INF_{it} = \alpha_i + \beta_1 INF_{it-1} + \beta_2 PBPER_{it} + \beta_3 PRPER_{it} + \beta_4 HADPER_{it} + \beta_5 GOV_{It} + \beta_6 PRPER * GOV_{it} + \beta_7 IMM_{it} + \beta_8 IWS_{it} + \beta_9 ISF_{it} + \beta_{10} FERT_{it} + \beta_{11} FLT_{it} + \beta_{12} NPYS_{it} + \beta_{13} PRN_{it} + \beta_{14} logPGDP_{it} + \beta_{15} HIVAIDS_{it} + e_{it} \quad (11)$$

External health aid and Governance Index

$$INF_{it} = \alpha_i + \beta_1 INF_{it-1} + \beta_2 PBPER_{it} + \beta_3 PRPER_{it} + \beta_4 HADPER_{it} + \beta_5 GOV_{it} + \beta_6 PBPER * GOV_{it} + \beta_7 IMM_{it} + \beta_8 IWS_{it} + \beta_9 ISF_{it} + \beta_{10} FERT_{it} + \beta_{11} FLT_{it} + \beta_{12} NPYS_{it} + \beta_{13} PRN_{it} + \beta_{14} logPGDP_{it} + \beta_{15} HIVAIDS_{it} + e_{it} \quad (12)$$

Based on objective 3, the study introduces governance first as an another independent variable serving as a moderating variable in equation 9 as well as interactive terms representing governance and disaggregated components of health financing on infant mortality into equations 10, 11 and 12.

Where $B_1, B_2 \ldots B_{15}$ are parameters, α_i is the constant parameter for the individual country (i) at time (t), e_{it} is the error term. Equations 9, 10, 11 and 12 look at the confounding effect expressed as introducing governance as an independent variable as well as an interactive term of disaggregated health financing and governance index on infant mortality in SSA.

Justification, Measurement of Variables and Sign Expectations

Dependent, intervening and independent variables in this study are chosen based on the objectives of this study, literature, data availability and the significance in the model chosen for the study. Prior expectations of the

signs of the independent variables are based on the theoretical literature and the findings from previous studies.

Infant Mortality

Infant mortality measures the number of children who die in a given year before they reach the age of one year per 1000 live births. Infant mortality is used in this study owing to its central role in defining the progress towards achieving SDG 3. Besides, infant mortality is measured as a very sensitive gauge of the availability, operation and efficiency of health care hence serves as a measure for comparing health systems and health status across countries. Moreover, countries commit financial resources to child health because the conditions of a child below age one is subject to the quality of the health system dominant in that particular country. Data was collected from World Bank, World Development Index (WDI) database on infant mortality.

Governance

Governance is used as an intervening variable that facilitates effective health financing. According to Kaufmann et al., (2006), in a data collection exercise by a World Bank team specifies a link between governance indicators and economic growth. Lazarova and Mosca (2006) affirm that governance has a real impact on a social development metric, such as infant mortality. The World Bank defines governance as the capacity to exercise authority in managing the economic and social development resources of a nation. The World Bank classifies governance into six main indicators: voice and transparency, political stability, policy efficiency and effectiveness, regulatory quality, rule of law and control of corruption. However, out of the six (6)

metrics, this study used three (3) — government effectiveness, control of corruption and regulatory quality, as literature indicates that the others (voice and transparency, political stability and rule of law) are thought to be least linked to health outcomes and therefore has no significant impact in undermining the measurement of governance. Choi et al. (2012) describes the government effectiveness by suggesting the efficiency of administration, the capability of civil servants, the quality of public service delivery and the integrity of government policy commitments and the freedom of public servants from political pressure. Corruption regulation monitors the different forms of bureaucrats' corruption, bribery, and illegal activities to grant certain licenses and permits.

Regulatory quality includes assessment of unfriendly practices and the capacity to control government excessively. Government effectiveness and regulatory quality measures have negative effect on infant mortality. Moreover, control of corruption affects child mortality negatively. The study concludes that governance has a negative effect on infant mortality. Data on governance is gathered from World Development Indicators (WDI).

Domestic Government Health Expenditure (PBPER)

Domestic Government health spending per capita includes recurring and policy (central and local) budgets capital expenditure, universal (or compulsory) health insurance fund (Kraay, 2012). It signifies an amount of public funds spent on an individual’s health in the form of investment into infrastructural development, remuneration and salaries, educating more health professionals, supply of biomedical drugs and scientific medical researches among others. All other things being equal, an increase in the domestic

government health expenditure signifies improved access to health care hence will ultimately lead to a decline in infant mortality rate. Domestic government health expenditure is therefore expected to have inverse relationship with infant mortality. Data on domestic government health expenditure is acquired from the World Bank World Development Indicator (WDI).

Domestic Private Health Expenditure (PRPER)

Private health expenditure also called domestic private health expenditure per capita looks at amount incurred by direct household expenditure such as out-of-pocket cost, private indemnity packages and payment made by private firms on an individual's health (Cleopatra & Eunice, 2018). Private health expenditure also plays a supporting role to public expenditure since most public funding activities are inadequate. It is against this backdrop that households and firms participate in health financing to help improve health outcomes. The study expects an inverse relationship between domestic private health expenditure and infant mortality in SSA. Data on domestic private health expenditure is acquired from the World Bank World Development Indicator (WDI).

External Health Expenditure (HADPER)

External health expenditure also known as health aid represents the amount of external aid spent on an individual in seeking health care. It serves as an important component particularly in high disease burden countries. These funds are used for the treatment of diseases like Malaria, Tuberculosis, HIV/AIDS and other related diseases. Moreover, funds are also used to procure medicines, train health professionals and build infrastructure which are expected to reduce infant mortality in SSA countries. Hence, health aid

reduces infant mortality. The expected sign for external health expenditure per capita is negative. Data on external health expenditure per capita is acquired from the World Bank World Development Indicator (WDI).

Immunisation against Measles (IMM)

Children within SSA mostly suffer from six childhood killer diseases. One of such disease is measles. This study justifies the inclusion of the variable immunization against measles because measles remains a leading cause of infant death (Lee, 2019). Moreover, SSA countries have sufficient data on measles immunization as recorded by World Bank. Measles may lead to death or disability including encephalitis-related blindness, deafness or intellectual disability. The treatment of measles among infants is expected to yield negative results. Data on infant immunized from measles is obtained from the World Bank World Development Indicator (WDI).

Water Facility Source (IWS)

Access to basic social amenities like water is very essential in seeking quality health care. For this analysis, water access refers to the percentage of persons using at least the basic water facility in the country. When individuals have access to basic drinking water facility especially in rural areas then there is the expectation that infant mortality rate will decline. On the contrary, when a high proportion of the people do not have access to a least basic drinking water then such country will experience high infant mortality rate. The justification for the inclusion of this variable is that a high level of infants' activities like bathing, eating and others are related to water availability. The expected sign regarding water access is negative. Data on water access is derived from the World Bank World Development Indicator.

Sanitation Facility (ISF)

Infant mortality is susceptible to the kind of sanitation facility available in a country. Sanitation facility access refers to the proportion of the populace that have access to at least basic sanitation facility in a country (WHO, 2019). Infant mortality is mostly influenced by the kind of sanitary conditions they find themselves. Households that have access to at least basic sanitation facilities is likely to experience low infant mortality rate. The justification for the inclusion of this variable is based on how infants are easily attacked by environmentally related diseases like cholera and others. The expected sign linked to the sanitation facility access is negative. Data on the sanitation facility access variable is acquired from the World Bank World Development Indicator.

Female Fertility Rate (FERT)

The fertility rate for females signifies the number of children born to a mother (WDI, 2019). In SSA countries, females are expected to give birth to many children hence the traditional setting is conducive for females in the society to give birth to plenty children. Based on this study, children who are born to females who are aged 15-49 years were used for this study. The justification of this variable hinges on the fact that number of children a female gives birth has high correlation with infant death as it predisposes the female to lack the ability to give birth to health children. When females give birth to many children then there is the probability that some of these children will die as a result of females inability to attend to all the health needs of many children. Hence, we expect that as many children are born to a woman then there will be more infant mortality. Thus, we expect a positive sign. Data on

female fertility is obtained from the World Bank World Development Indicator (WDI).

Female Literacy Rate (FLT)

Female literacy rate refers to the proportion of female ages 15 and beyond, who can both read and write a short, concise statement about their everyday lives (Mensch, Singh & Casterline, 2005). Female literacy rate is included in this study because females who can read and understand medications given them at medical facilities are able to follow prescriptions to increase infant survival in SSA. When females are literate then infant mortality will reduce in SSA. Hence, the study expects a negative sign. Data on female fertility rate is obtained from the World Bank World Development Indicator (WDI).

Number of Physicians (NPYS)

Physicians include generalist and specialist medical practitioners that are found within medical facilities with the aim of meeting the health care needs of all people. The number of physicians in the country is included because they perform a significant role in delivery quality health care services. When the number of physicians available in the country is high then it is expected that infant mortality rate will decrease. Conversely, when the number of physicians available in medical facilities is low then infant mortality is expected to increase. It is worthy to note that the expected sign is negative. Data on the number of physicians is obtained from the World Bank World Development Indicator (WDI).

Prenatal Care (PRN)

The study considers the percentage of women who received prenatal care services before delivery. By this measure, the study takes into consideration the proportion of women who were under the supervision of medical personnel (doctor, nurse or midwife) before delivery. Treatments given to pregnant women before delivery go a long way to reduce mortality among infants. Prenatal care variable is included in this study because the medications given to pregnant women protect infants from diseases and other infections within the one-year period after birth. Women who receive prenatal care experience low infant mortality compared to their counterparts who do not receive such kind of prenatal care. The expected sign of prenatal care is negative. In this study, data on prenatal care is acquired from the World Bank World Development Indicator (WDI).

Gross Domestic Product per Capita (PGDP)

Several empirical works exist which suggest that health outcomes improve when there is an increase in per Gross Domestic Product (PGDP) in an economy (Gupta, Jalles, Mulas-Granados & Schena, 2018; Issa & Ouattara, 2005). On this aforementioned basis, this study include PGDP studies as a very important variable in determining health outcomes. When there is an increase in per GDP then public, households and firms will have enough funds to pay for health services. Moreover, when households experience higher incomes then we expect households to have improved health care access.

Higher income also enhance households' ability to demand more health care. According to Anyanwu and Erhijakpor (2009), higher incomes enable governments to provide improved health infrastructural facilities to help in

health delivery. This gives the indication that an increase in per GDP will lead to a rise in health care delivery hence a reduction in infant mortality. Per GDP is predicted to have a negative relationship with infant mortality. Data on per GDP variable is acquired from the World Bank World Development Indicator (WDI).

HIV/AIDS Prevalence (HIVAIDS)

One of the diseases that affects the population in SSA is the prevalence of HIV/AIDS. South Africa, Lesotho and Nigeria rank very high among countries affected by HIV/AIDS across the globe (WHO, 2019). Although HIV/AIDS is not the only disease that affects the population in SSA countries. Infants living with HIV apply to the number of children between the ages of 0 and 14 diagnosed with HIV (WDI, 2019). This is used as a proxy for infants affected by the prevalence of HIV/AIDS. Due to the unrestricted movement of citizens from one country to another in the SSA region, the spread of HIV/AIDS is very high. This variable is included in this study because infants are therefore more susceptible to the spread of HIV/AIDS even though they are sexually inactive. Hence, we expect a positive sign. Data on HIV/AIDS prevalence is accessed from the World Bank World Development Indicator (WDI).

Using Principal Component Analysis (PCA) to generate Governance Index

Preliminary test results indicates that governance indicators (government effectiveness, control of corruption and regulatory quality) are highly correlated hence multicollinearity problem could occur when used in the same model. Based on Globerman and Shapiro (2002) and Buchanan et al.

(2012) computations, the study computes a composite governance index via the Principal Component Analysis (PCA). The Principal Component Analysis (PCA) is a multivariate approach that analyzes a data table in which many interrelated functional dependent variables explain a result. The advantage of PCA over the additive index (AI) is that the PCA method presents a multi-variable numerical procedure that creates an orthogonal variable set called principal component with the purpose of obtaining vital information from the governance indicators (government effectiveness, control of corruption and regulatory quality) used in this study.

Theoretically, adopting the PCA method

Let $Q = X\,X^T$ be the N x N matrix (13)

$$Q = X\,X^T = [\,x_1 - \pi\;\; x_2 - \pi \ldots\ldots\ldots x_n - \pi\;\; [(x_1 - \pi)T] \quad (14)$$

Let X be the N x n matrix with columns

$$X_j = \pi + \sum_{i=1}^{i=n} gjie_i \quad (15)$$

Where e_i are the n eigen vectors of Q with non-zero eigen values.

$$g_{ji=(X_j-}\;\pi)\,.\,e_i \quad (16)$$

The scalar g_{ji} are the coordinates of X_j in the space.

Sort the eigenvectors e_i according to their eigenvalue

$\lambda 1 \geq \lambda 2 \ldots\ldots\ldots \lambda n$

Assuming that $\lambda 1 \approx 0\; if\; i > k$

Then $X_j \approx \pi + \sum_{i=1}^{i=k} gjie_i$ (17)

The study then chooses the principal eigenvector with the highest value

$$w^{\emptyset} = \underset{w:\,IwI\,=\,1}{\arg\max} w^T C^w \quad (18)$$

$$\lambda max^{(C)} = \max w^T C^w \quad (19)$$

$$\lambda max^{(C)} = w^{T} C^{w} \quad (20)$$

$$X = UDV^{T} \quad (21)$$

Where X is the generated composite index

Based on multivariable analysis, a Principal component analysis (PCA) approach is used for variables of governance measures showing significant contributions to the total governance score metric (Yvas & Kumaranayake, 2006). The PCA score factor with the highest eigen value is used, which properly defines a SSA country's level of governance. The PCA has an advantage in minimizing calculation problems, such as recall bias, and in minimizing the difficulty of correlated results. The combined governance score factor (index) is used in the regression for analysis.

Table 1: Definition and Measurement of Variables

Variable	Type	Definition and measurement	Expected sign
INF	Discrete	In a given year, the number of babies who perish before attaining the age of one year per thousand live births.	
GOV	Discrete	A composite index for government efficiency, control of corruption and monitoring quality	-
GVT	Discrete	Measures the consistency of government bureaucracy, civil servant competence, public service quality, the integrity of the government's policy actions, and the freedom of government employees from government pressure.	-
CRPT	Discrete	Measures different aspects of corruption, bribes and illegal activities of bureaucrats	-
RQ	Discrete	Measures market unfriendly policies	-
PBPER	Discrete	Amount of public funds spent on an individual's health (current US$)	-
PRPER	Discrete	Amount incurred by direct household expenditure (current US$)	-
HADPER	Discrete	Amount of external aid spent on an individual in seeking health care (current US$)	-
IMM	Discrete	Percentage of infant immunised against measles	-
IWS	Discrete	Percentage of the people who have access to at least basic water facility	-
ISF	Discrete	Percentage of the people that have access to at least basic sanitation facility	-
FERT	Discrete	Fertility rate (births per woman)	+
FLT	Discrete	Percentage (%) females who can read and write	-
NPYS	Discrete	The number of generalist and specialist medical practitioners that are found within medical facilities (per 1000)	-
PRN	Discrete	Percentage of women who received prenatal care services before delivery	-
PGDP	Discrete	GDP per capital (current US$)	-
HIVAIDS	Discrete	The prevalence of HIV/AIDS among the population	+

Infant mortality is the dependent variable and Governance indicators (government effectiveness, corruption and regulatory quality) are intervening variables. All other variables are independent variables.

Source: World Development Indicators (2020)

Post Estimation Techniques

Arellano and Bond (1991) suggests the Sargan statistics as a measure for testing overriding identity among the instrument used in the study. Based on their analysis, the result is supposed to be insignificant to indicate no overriding identity to confirm that the instruments used in the study are efficient. Moreover, autocorrelation test (AR-test) is the second post estimation technique adopted in this study (Roodman, 2009). The study adopts the Arellano and Bond test of second order serial correlation with the disturbance term to guarantee consistent estimations (Arellano & Bond, 1991). The AR-test reports both the first and second difference autocorrelation in default mode however the lag levels can change. Based on a null hypothesis, there is no autocorrelation in the first and second difference error indicating the study fails to reject the null hypothesis. This study reports only the second difference autocorrelation as part of the estimated results.

Data Analysis

The study employs both descriptive and quantitative analysis. Descriptive statistics gives preliminary view of results. Moreover, the study adopts the Generalised Method of Moment (System-GMM) introduced and popularized by Arellano and Bond (1991) to estimate the differential and comparative effects of disaggregated health financing components on infant mortality in SSA and sub-regional groups in SSA. Moreover, the same System-GMM is used to examine the confounding effect of governance on the relationship between disaggregated components of health financing and infant mortality in SSA. All estimations are carried out using STATA software.

Sources of Data

Data on dependent, intervening and explanatory variables used in this study are solely secondary and obtained from the World Bank World Development Indicators (WDI). The variables are annual data from the respective countries. The study covers forty - two (42) countries in Sub Saharan Africa over the study period from 2000 to 2016. These countries are selected based on data availability.

Chapter Summary

This chapter develops and presents the appropriate methodological framework for carrying out this study. Panel data corresponding to 42 sub Saharan Africa countries is employed from 2000 to 2016 for all the variables in this study. Moreover, the Generalised Method of Moment (System-GMM) is used to estimate the differential effect of disaggregated components of health financing on infant mortality in SSA, across SSA sub regions and analyse the confounding effect of governance on the relationship between disaggregated components of health financing and infant mortality. This chapter has set out a good platform for the interpretation of coefficients in the subsequent chapter based on the regression outputs and to prescribe policy recommendations based on the study findings.

CHAPTER FIVE

RESULTS AND DISCUSSION

Introduction

This chapter presents the results and discussions of the study. This analysis starts with descriptive statistics and then follows with results based on the aforementioned objectives.

Descriptive statistics

Prior examination of any dataset is very important before conducting regression analysis. This is done so that there will be a proper feel of the dataset to know the kind of information that the dataset carries. Summary statistics provides us with a number of characteristics of our datasets. These are: a measure of central tendency (mean), a measure of dispersion (standard deviation), measures of normality – kurtosis (measures the degree of peakness or flatness of the series) and skewness (measures the degree of asymmetry of the series). The results of the summary statistics is given in Table 2.

Table 2: Summary statistics of variables

Variable	Obs.	Mean	Sd.	Min	Max	Skew.	Kurt.
Infant mortality	714	63.327	25.463	11.8	142.4	0.143	2.698
Public health expenditure	714	44.129	81.116	0.183	572.884	2.843	11.940
Private health expenditure	714	36.547	51.111	1.426	307.861	2.704	10.423
External health aid	711	10.087	12.294	0	98.916	3.030	15.822
Immunisation against measles	714	75.194	19.159	8	99	-0.851	2.994
Access to water (% of population)	714	60.694	16.805	18.695	99.866	0.225	2.709
Access to sanitation (% of population)	714	31.577	22.383	3.403	100	1.212	4.003
Fertility rate	714	50.027	12.568	16.561	64.128	-1.198	3.669
Female literacy rate	714	4.9702	1.283	1.36	7.679	-0.602	3.117
Number of physicians	714	0.2345	0.103	0.090	0.439	0.378	2.089
Pre-natal care	714	83.871	4.949	72.82	91.875	-0.581	2.667
Log of GDP per capita	714	6.867	1.148	4.717	10.040	0.683	2.681
HIVAIDS	714	10.693	0.072	10.544	10.780	-0.588	2.097
Governance	714	-5.76E-10	1.000	-2.953	3.136	0.140	3.786

Note: Obs represents observation, Min. represents minimum, Max. represents maximum, Sd. Represents standard deviation, Skew. represents Skewness, Kurt. represents kurtosis
Source: Gamette (2020)

From Table 2, on the average 63 infants die among 1000 live births with a standard deviation of 26 infant deaths. The maximum and the minimum values 12 and 142 infant deaths among 1000 live death respectively. For Public health expenditure, Private health expenditure and External health aid, their mean values are US$44, US$36 and US$10 respectively. The minimum and maximum for public health expenditure are US$ 0.18 and US$ 573. In the case private health expenditure, both the minimum and maximum are US$ 1.4 and US$ 308. External health aid recorded US$ 0 and US$ 99 as its minimum and maximum values. These suggest that there are much variability in all the health expenditures however very high with public health expenditure and private health expenditures.

The governance variable records a negative mean value of -0.0000000576 with minimum value of -2.953 and maximum value of 3.136. This suggests that governance level differs very much from one country to another country within the SSA region. Over the study period, an average of 4 infants are born to women above 15 years whiles 10.7% of the population were disease-ridden with HIV/AIDS. Moreover, an average of 75%, 60% and 31% of infants are immunized against measles, population have access to basic water facility and population have basic sanitation facility respectively. Moreover, an average of 24 medical practitioners are available in medical facilities to treat 1000 individuals. Similar meaning and interpretations go for women who have received prenatal care (PRN) and female literacy (FLT).

Table 2 also shows that immunization against measles (IMM), female fertility (FERT), female literacy (FLT), pre-natal care (PRN) and HIV/AIDS prevalence (HIVAIDS) are negatively skewed. All other variables are

positively skewed. The derived kurtosis results indicate that the data is light-tailed with lower kurtosis values. External health expenditure (HADPER) records the highest (15.87) peak whiles number of available physicians (NPYS) records the lowest (2.089472) kurtosis value.

Differential Effects of the Disaggregated Components of Health Financing on Infant Mortality in SSA

This study's foremost objective is to estimate the differential effects of the disaggregated components of health financing on infant mortality in SSA. In this case, the study focuses on effect of public health expenditure, private health expenditure and external health aid on infant mortality in SSA for the period 2000 to 2016. The results are presented in Table 3.

Table 3: Disaggregated Components of health financing on infant mortality

Variables	Coefficient	Standard Error
Infant mortality (-1)	0.950***	0.0185
Public expenditure	-0.0109***	0.00153
Private expenditure	-0.00886***	0.00225
External health aid	-0.0143***	0.00550
Measles immunization (%)	-0.108***	0.00833
Access to basic water facility (% of population)	-0.0730***	0.0103
Access to basic sanitation facility (% of population)	-0.0331***	0.00452
Female fertility rate	-4.675***	0.545
Female literacy rate	0.0165**	0.00348
Number of physicians	-0.404	1.031
Pre-natal care	-0.0146	0.0166
Log of GDP per capita	-1.180***	0.152
HIVAIDS	7.339***	1.258
Constant	-31.10***	11.73
DIAGNOSTIC		
S stat	7.54	
Prob.	0.674	
AR(2)	0.907	
Obs.	665	

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ represents significance level at 10%, 5% and 1%.
Source: Gamette (2020)

From Table 3, the lag effect suggests that the previous year's infant mortality has a positive significant relationship with the current infant mortality at 99% confidence level. Intuitively, this implies that a 1% increase in previous infant mortality level leads to 95% increase in current infant mortality level.

Results from Table 3 indicates that each disaggregated health financing component (public, private and external health aid) has a negative effect on infant mortality at a 1% significance level each in SSA over the study period (2000-2016). The result is in consonance with other studies (Berger & Messer, 2002) which indicate that health expenditures are essential elements in enhancing health outcomes at both the individual and national levels.

Specifically, over the study period, the coefficient of public health expenditure is -0.0109 and it is statistically significant at 1 percent. Intuitively, when SSA countries increase public health expenditure by an additional US$1000, 10 infants survive among 1000 live births. This validates the findings of Gupta et al., (2001) and Gottret and Schieber (2006) that public spending contributes to reducing infant mortality contrary to Houweling, Kunst, Looman and Mackenbach (2005) and Baldacci et al., (2002) who found that public health expenditure is insignificant on infant mortality. At 1 percent significance level, private health expenditure has a coefficient of -0.00886. This indicates that households or private individuals that spent an addition US$1000 on health care results in additional 9 infants surviving among 1000 live births. This finding is consistent with Gupta et al., (2001) which corroborated that private health expenditure has significant effect on infant mortality. However, Novignon & Novignon (2012) corroborates that the effect

of public health expenditure is greater than that of private health expenditure as also shown by this study. The reason for this phenomenon is that most health facilities in SSA countries are public owned and financed. Hence, public health spending is projected to benefit a larger portion of the population than private health spending.

At 1 percent significance level, external health aid records a coefficient of -0.0143. This suggests that when SSA countries commit an additional US$1000 to healthcare, 14 infants survive among 1000 live births. This result lends support to studies like Mishra and Newhouse (2009) and Drabo and Ebeke (2011) indicating that external aid is a critical driver in influencing infant mortality across developing countries. From Table 3, external health expenditure is the most effective financing mechanism in saving most infants compared to both public and private expenditures. One underlying reason is that external health aid is accompanied by stringent measures coupled with policies directions regulating its usage. Programmes such as Sector Wide Approach (SWAP) dictates specific prioritized areas such as maternal health, child health, chronic diseases and infectious diseases are targeted by external donors in the region. Hence, external health aid finances immunization of infants through provision of vaccines, malaria drugs, HIV vaccines, provision of insecticides treated nets and others (Msuya, 2005). SSA countries are therefore compelled to follow strict measures attached to these external funds for curing varied ailments.

Immunization against measles (IMM), proportion of population with access to basic water facility (IWS), proportion of population with access to basic sanitation facility (ISF), female fertility (FERT), Gross Domestic

Product per capita (PGDP) and HIV/AIDS prevalence all exhibit negative effects on infant mortality in SSA at 1% significant level. Specifically, the coefficient of immunization against measles is -0.108 and it is statistically significant at 1 percent. This means when an additional 1% infant are immunised against measles in SSA countries, it will result in 11% infants more surviving among 1000 live births.

On the contrary, female literacy rate (FLT) has a positive effect on infant mortality at 5% statistical significant level. Female literacy has a positive effect (0.0165) on infant mortality at 5 percent significance level. This implies that when 1% more of females can read and write then 1.7% more of infants die among 1000 live births. This is contrary to intuition because female literacy without other additive and conjunctive constituents like gender equality and equitable income distribution could result in the aforementioned effect on infant mortality contrary to findings from Kateja (2007) where improved literacy rate among females, females become aware of the child's nutritional requirement for longevity.

Access to water records a coefficient of -0.0730 whiles access to sanitation records a coefficient of -0.0331 each at 1 percent significance level. When 1% more of the population have access to basic water facility and sanitation facility there was a 7% and 3% reduction in infant mortality. From Table 4, female fertility has a negative effect (-4.675) on infant mortality at a 1 percent significance level. This suggests when women fertility improves by 1 percent; infant mortality reduces by 46 percent. When a one percent increase in women can read and write, infant mortality increases by 1.6 percent. Intuitively, female fertility has a negative sign because females with proper

medications accompanied by right birth spacing among infants are likely to reduce infant death contrary to our expectation.

Gross Domestic Product per capita had -1.180 and HIV prevalence recorded 7.339 indicating negative and positive effect on infant mortality at 1 percent significance level each. When SSA countries increase their output (PGDP) on average by 1%, it leads to a 1% reduction in infant mortality. This validates the findings from Erdogan, Ener & Arica (2013) that economic growth (PGDP) inversely affects infant mortality. Lastly, when an additional 1% of infants contracts HIV/AIDS, it results in a 7% increase in infant mortality.

From Table 3, the probability value (P- value) of their Sargan Statistics was insignificant (0.674), which implies that there is no overriding identity and hence the first lag of infant mortality are efficient. AR (2) value (0.907) indicates failed to reject the null hypothesis that there is no serial correlation. Thus, there is no multicollinearity in the variables used in the model.

Effect of disaggregated components of health financing on Infant Mortality across SSA sub-regional groups

The results in Table 3 give the general picture for the entire SSA sample. However, there are disparities in health spending across SSA sub-regional groups hence the need to interrogate how each health financing component affects infant mortality in the various sub-regions. This will deepen understanding of the issues within the sub-regional groups in SSA and guide sub-regional health policymaking. The results are presented in Table 4.

Table 4: Effect of Each Disaggregated health financing component on Infant Mortality across sub-regional groups in SSA

Variable	East Africa	Central Africa	West Africa	South Africa
Infant Mortality (-1)	0.911***	0.922***	1.042***	0.985***
	(0.0200)	(0.0459)	(0.0374)	(0.0335)
Public expenditure	-0.0153***	0.0194**	-0.0400***	-0.0246***
	(0.00516)	(0.00752)	(0.0116)	(0.00817)
Private expenditure	-0.0755***	0.0252***	-0.171***	-0.000152
	(0.0199)	(0.00478)	(0.0512)	(0.00427)
External health aid	-0.0562***	-0.0329*	0.0316	-0.0345**
	(0.0207)	(0.0189)	(0.0238)	(0.0148)
Immunisation against measles	-0.0335***	-0.0426**	0.0278	0.0258
	(0.0115)	(0.0207)	(0.0173)	(0.0220)
Access to water (% of population)	0.0274	0.0384	-0.0896***	0.0159
	(0.0255)	(0.0470)	(0.0244)	(0.0348)
Access to sanitation (% of population)	-0.00532	0.0914*	-0.0615***	-0.140***
	(0.0133)	(0.0480)	(0.0170)	(0.0346)
Female fertility rate	2.067***	-0.177	0.326	-0.283
	(0.404)	(0.398)	(0.215)	(0.514)

Table 4 continued

Female literacy rate	0.000877	0.0196*	-0.0178	0.0196
	(0.00967)	(0.0117)	(0.0118)	(0.0138)
Number of Physicians	-3.679***	3.243**	-2.074	-2.096
	(1.253)	(1.606)	(1.863)	(2.091)
Pre-natal care	-0.0333	-0.00376	-0.0259	-0.0147
	(0.0223)	(0.0307)	(0.0289)	(0.0342)
Log of GDP per capita	3.579***	-3.977***	8.983***	4.952***
	(1.142)	(0.994)	(2.164)	(1.799)
HIVAIDS	-2.416	10.30*	-9.220***	-6.995**
	(1.604)	(5.288)	(3.016)	(3.515)
Constant	2.227	-82.05*	45.75**	44.49
	(19.49)	(44.05)	(23.15)	(27.45)
DIAGNOSTIC				
S stat	4.78	8.45	4.45	4.33
Prob.	0.96	0.672	0.974	0.987
AR(2)	0.766	0.514	0.851	0.420
Obs.	123	142	240	160

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$ represents significance level at 10%, 5% and 1%.
Source: Gamette (2020)

Results from Table 4 indicates that the first lag of infant mortality (INF -1) has a significant positive effect on current infant mortality at 1 percent significance level. Specifically, the results show that East Africa, Central Africa, West Africa and South Africa records 0.911, 0.922, 1.042 and 0.985 respectively. The implication is that a 1 percent increase each in previous year's infant mortality rate in East Africa, Central Africa, West Africa and South Africa leads to a 91 percent, 92 percent, 104 percent and 99 percent increase in infant mortality respectively.

Table 4 also shows that the probability values of the Sargan Statistics for model 2 are 0.96, 0.672, 0.974 and 0.987 for East Africa, Central Africa, West Africa and South Africa respectively indicating no overriding identity. This specifies that the lag of infant mortality employed in model 2 is efficient. Model 2 also fails to reject the hypotheses that there is no serial correlation among the variables employed in the model.

In addition, Table 4 shows that public health expenditure has a negative effect on infant mortality in East Africa at a statistical significance level of 1%. This study confirms the findings of Murunga et al. (2019) that public health expenditure improves health outcomes (infant mortality) in Kenya. This implies that when governments in East Africa commit an additional US$1000 to healthcare, 15 more infants survive among 1000 live births. On the contrary, Central Africa's public health expenditure shows a positive effect on infant mortality at 5% statistical significance level. The inverse relationship is in consonance that reported by Anyanwu and Erhijakpor (2009). When Central African governments spend an additional US$1000 to healthcare, an additional 19 infant deaths. This is contrary to

intuition because countries located in the central part of SSA like Central African Republic, Chad and Cameroun experience political instability with frequent civil wars, hunger and death which render government health spending ineffective in reducing infant mortality.

Public health expenditure has negative effect on infant mortality in West Africa and South Africa at a 1% statistical significance level each. This study confirms recent findings from Kiross et al. (2020) on the negative relationship between public expenditure and infant mortality in West Africa. US$1000 each on healthcare, it results in a reduction in infant mortality by 40 and 24 infants among 1000 live births.

At a 1% statistical significance level, private health expenditure has negative effect on infant mortality in both East Africa and West Africa. Novignon and Novignon (2012) and Oluwaseun (2019) confirms similar relationship between private health expenditure and infant mortality in SSA countries and West Africa respectively. The implication is that when private households in East Africa spend an additional US$1000, infant mortality reduces by 76 infant. In the case of West Africa, an additional US$1000 spending on healthcare results in 171 more infants surviving among 1000 live births.

On the contrary, private health expenditure has a positive effect on infant mortality in Central Africa at 1% statistical significance level. The implication of the result is that a US$1000 private health spending leads to 25 more infant death among 1000 live births. Such a phenomenon is contrary to intuition because infants are the most vulnerable and susceptible group to

poverty in the sub-region due to the country's instability as prone to civil wars, hunger and diseases which causes numerous infants death.

In the case of South Africa, a US$100,000 private spending on health results in infant deaths reducing by 15 infants. This suggests that private individuals and entities have to spend huge amounts of funds in order to save infants. Looking at the disease burden of the South Africa, private spending is targeted specifically at adults' ailments like HIV/AIDS treatment, tuberculosis and pneumonia. Anyanwu and Erhijakpor (2009) indicates that the disease structure of South African countries reveals a positive relationship between private health spending and infant mortality despite huge spending from private individuals and entities.

External health expenditure also shows diverse effects on infant mortality across SSA sub regions. External health expenditure has negative effect on infant mortality in East Africa, Central Africa and South Africa at 1%, 10% and 5% statistical significance levels respectively. Mishra and Newhouse (2009) indicates similar results that external health aid reduces infant mortality in WHO countries. By committing US$1000 to healthcare, East African countries are able to save on average an additional 56 infants among 1000 live births over the study period. In the case of Central Africa, an incremental spending of US$1000 on healthcare reduces infant mortality by 33 infant births. In terms of infants saved from external aid in the various sub regions, Central Africa has the lowest because it takes a longer time for unstable economies to address the health conditions of vulnerable groups like infants. On the contrary, external health aid has a positive effect on infant mortality in West Africa. A plausible explanation is that donor funds might

flow into the West African sub-region however when there is a mismatch between the targets of these funds and the country child care needs then infant death will continue to surge despite the flow of funds.

In real terms, 35 infants survive after South African countries commit an additional US$1000 to general healthcare. However, external health aid has an insignificant effect on child health in West Africa over the study period. However, external funds keeps flowing into the sub region, such funds are mainly channeled into maternal health, HIV/AIDS treatment, tuberculosis and others but not specifically child health. External health aid has a 0.0316 effect on infant mortality. One can also attribute the contrary sign to donor funds which do flow directly into healthcare but do not directly contribute to infants' survival within their first year. For example, funds can be used to pay for the remuneration of hospital staffs however if they show lackadaisical attitude towards attending to healthcare needs of infants, infant mortality will still surge.

The Gross Domestic Product per capita (PGDP) has significant effect on infant mortality across the four (4) sub-regions (East Africa, Central Africa, West Africa and South Africa). West Africa witness a decrease of 3.9% in infant mortality when such countries commit an additional US$1 increase in PGDP at a 1% statistical significance level. This is inconsistent with findings by Erdogan et al. (2013) who indicates Gross Domestic Product per capita (PGDP) has a positive effect on infant mortality. On the contrary, East Africa, West Africa and South Africa witness their infant mortality increasing by 3.6%, 8.9% and 4.9% respectively by a US$1 increase each in their Gross Domestic Product per Capita (PGDP) at a 1% statistical significance level.

When countries fail to spend the stipulated 15% of the Gross Domestic Product on health then countries within East Africa, West Africa and South Africa can witness high levels of infant death.

In Central Africa, a 1% increase in female literacy resulted in infant mortality increase by 19 infant deaths at 10% statistical significance level. In East Africa, a 1% increase in infants immunized against measles results in 34 infants surviving among 1000 live births at a 1% statistical significance level. In the case of Central Africa, a 1% increase in infants immunized against measles leads to 43 infants surviving among 1000 live births at a 5% statistical significance level. A 1 percent increase each in the number of infants immunized against measles each in both West Africa and South Africa resulted in 28 and 26 infant deaths respectively. This could be explained as though a high percent of infants could be immunized against measles however if there is a high sudden infant deaths caused by the other childhood killer diseases like polio and diphtheria then infant deaths will continue to rise.

It is only West Africa that when a 1% increase in the population have access to at least basic water facility leading to 87 reduction in infant mortality at 1% statistical significance level. In Central Africa, a 1% increase in population with basic sanitation facility result in 91 infants succumbing to death within their first year birthdate at a 10% significance level. On the other hand, a 1% increase in the population with access to sanitation facility leads to 62 infants surviving among 1000 live births at a 1% statistical significance level. South African countries witness a 140 reduction in infant deaths when there is a 1% increase in population that have access to basic sanitation facility.

As a high percentage of the population gets access to basic water facility, infant mortality is expected to decline. However, Table 4 indicates that percentage of the population access to basic water facility has a 0.0274, 0.0384 and 0.0159 effect on infant mortality on East Africa, Central Africa and South Africa. Intuitively, when a 1 percent each increase of the existing population have access to basic water facility, infant mortality increases by 27, 38 and 16 in East Africa, Central Africa and South Africa respectively. Even though more people could have access to water facility, when the available water is contaminated then infant mortality will continue to surge. In the same vein, access to sanitation facility shows a positive (0.0914) effect on infant mortality. Sanitary related diseases like cholera, diarrhea and dysentery can still pose as major health challenges to infant when sanitation facilities lack the needed improvement.

Female fertility has positive effects thus 2.067 in East Africa and 0.326 in West Africa. A 1% increase in fertility rate increases East Africa's infant deaths by 2 infants at a 1% statistical significance level. The implication underlying such positive effect is that when females have the tendency to give birth to more infants, the formers' ability to take good care of new infants deteriorates hence increasing infant deaths. Female literacy rate has positive effects on infant mortality in East Africa, Central Africa and South Africa. Specifically, as female literacy rate increases by 1 percent each in East Africa, Central Africa and South Africa results in an increase in infant mortality by 1, 20 and 20 infant deaths respectively. Services provided by health professionals remain a critical component in the efforts to reduce infant mortality across the Africa region (Gwatkin, 2000). In East African countries, an additional

increase in the number of physicians culminate in a reduction in infant mortality by 4 infants at a 1% statistical significance level. Central Africa records 3 additional infant deaths after employing an additional physician. When the number of physicians who attend to a 1000 population increase however with child health lacking a corresponding increase allocation in physicians can result in a surge in infant deaths.

Finally, a 1% increase in HIV/AIDS prevalence in Central Africa leads to a 10 more infant deaths at a 10% statistical significance level. A 1% increase in HIV/AIDS prevalence results in a decrease of infant mortality by 9 infants surviving in West Africa. In the South Africa sub-region, a 1% increase in HIV/AIDS prevalence results in a reduction of infant mortality by 7 infants surviving among 1000 live births. Intuitively, there can be high prevalence of HIV/AIDS in East Africa, West Africa and South Africa however infant deaths could still reduce as infants are within the category of people who are not sexually active to contract the virus hence a consequent reduction in infant mortality.

Results from the Principal Component Analysis

The Principal Component Analysis (PCA) is used to generate a governance index by maintaining key inherent features of the governance measures (government effectiveness, control of corruption and regulatory quality) used for this study.

Table 5: Principle Component Analysis

Variable	Component	Eigenvalues	Proportion
Control of corruption	0.7292	2.64189	0.8806
Govt. Effectiveness	0.5986	0.275624	0.0919
Regulatory quality	0.5868	0.0824875	0.0275

Source: Gamette (2020)

Table 5 shows that control of corruption explains the highest variation in the constructed governance index. Specifically, control of corruption explains about 88.1 percent of the total variation in the data. However, regulatory quality explains the lowest variation in the total data set. Regulatory quality explains about 2.8 percent of the variation in the governance indicators dataset. Thus, based on the first component, governance index was constructed. Moreover, Eigenvalue greater than 1 is used as the criterion for extracting factors. Given the threshold for the inclusion of a variable as 0.5, all three observed variables are retained.

Confounding Effect of Governance on the relationship between Disaggregated Health Financing and Infant Mortality in SSA

In examining the confounding effect, the study does that from two perspectives. First, the study examines the moderating effect of governance on the relationship between disaggregated health financing components and infant mortality in SSA. In the second perspective, the study examines the mediating effect of governance on the relationship between disaggregated health financing and infant mortality in SSA countries.

Moderating Effect of governance on the relationship between Disaggregated Health Financing Components and Infant Mortality in SSA

Table 6: Moderating Effect of Governance on Infant Mortality in SSA

Variable	Coefficients	Standard Error
Infant Mortality (-1)	0.959***	0.0232
Public expenditure	-0.0118***	0.00337
Private expenditure	-0.00238**	0.00392
External health aid	-0.0157*	0.00904
Governance	-0.544**	0.266
Immunisation against measles	0.0342*	0.0201
Access to water (% of population	0.00329	0.0260
Access to sanitation (% of population)	-0.121***	0.0246
Female fertility rate	-1.425***	0.215
Female literacy rate	0.0226**	0.0109
Number of physicians	-1.387	1.802
Pre-natal care	-0.0332	0.0304
Log of GDP per capita	1.616***	0.432
HIVAIDS	-2.593	2.129
Constant	26.50	21.64
DIAGNOSTIC		
S stat	7.03	
Prob.	0.797	
AR(2)	0.415	
Obs	665	

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ represents significance level at 10%, 5% and 1%.
Source: Gamette (2020)

At a 1 percent significance level, a 1unit increase in public health expenditure leads to a 0.0118 reduction in infant mortality. This implies that when public health expenditure increases by an additional US$ 1000, 12 more infants live among 1000 live births. This result explains that more public

spending in the health sector will ultimately lead to reduction in infant deaths as confirmed by Novignon and Novignon (2012). In the same vein, when private health expenditure increases by 1 unit, infant mortality reduces by 0.00238. This suggests that when private health expenditure increases by US$ 1,000, infant mortality reduces by 2 infants. As confirmed by Anyanwu & Erhijakpor (2009I), private health expenditure has the potency of reducing infant mortality when directed towards child health. In the case of external health aid, a 1 unit increase foreign funds commitment to health leads to a 0.0157 reduction in infant mortality. Specifically, when an additional US$ 1,000 of external health aid is channeled to health, 16 more infants survive among 1000 live births. This finding is parallel to Mishra and Newhouse (2009) who explained that external health aid complements both government and private individuals' spending on health to reduce infant mortality in WHO countries.

The coefficient of Governance is found to be -0.544 and it is statistically significant at 5%, indicating a negative effect on infant mortality. This means that when governance improves by 1 unit, infant mortality decreases by 1 infant surviving. This result is in line with study by Farag et al (2013) which find that governance contributes to reducing infant mortality. When the general governance measures are strengthened then there is an opportunity for an additional infant to survive among 1000 live births. However, this finding is contrary to Iheonu, Agbutun, Omenihu, Ihedimma & Osuagwu (2019) indicating that governance increases infant mortality in SSA signifying existence of poor governance structures.

Comparing the results of Table 2 and Table 6, the introduction of governance as another independent variable facilitates both public health expenditure and external health expenditure in reducing infant mortality than when governance is absent. When governance is present, public health expenditure and external health aid are able to save 12 and 16 infants respectively. The aforementioned numbers of infants that survive are higher than 11 and 14 infants in either case surviving without governance. Hence, the study can infer that governance act as a catalyst (moderator) for both public health expenditure and external health aid. On the other hand, even though private health expenditure reduces infant mortality in the presence of governance, its impact is less than when governance is vague when assessing the former's impact on infant mortality in SSA countries.

The Mediating Effect of governance on the relationship between each of the disaggregated components of health financing and infant mortality in SSA

This section presents mediating effect of governance on the relationship between disaggregated components of health financing and infant mortality in SSA over the study period. This is based on the study's viewpoint that increasing health financing components alone in an economy does not spontaneously result in decline in infant mortality in that the existence of governance might perform a mediating role in the relationship between health financing and infant mortality (Jayasuriya & Wodon, 2003). Specifically, this section concentrates on the interaction between disaggregated components of health financing mechanisms and governance (GOV) on a case-by-case basis.

Table 7: Confounding effect of Governance and disaggregated health financing on infant mortality in SSA

Variables	Model 1	Model 2	Model 3
Infant Mortality (-1)	0.935***	0.919***	0.876***
	(0.0668)	(0.0589)	(0.0438)
Public expenditure	-0.0427***	-0.0259***	-0.0207***
	(0.0107)	(0.00615)	(0.00433)
Private expenditure	-0.0576***	-0.0545***	-0.0236**
	(0.0210)	(0.0201)	(0.0105)
External health aid	-0.0151	-0.000550	-0.0266***
	(0.00946)	(0.00697)	(0.00982)
Immunisation against	0.0181	-0.00314	-0.0110
measles	(0.0434)	(0.0343)	(0.0299)
Access to water (% of	-0.0993***	-0.100***	-0.0829***
population)	(0.0236)	(0.0214)	(0.0164)
Access to sanitation (% of	-0.0884***	-0.0868***	-0.0871***
population)	(0.0199)	(0.0166)	(0.0162)
Female fertility rate	0.838***	0.806***	0.888***
	(0.123)	(0.118)	(0.100)
Female literacy rate	0.0126	0.0103	0.0109
	(0.0104)	(0.00953)	(0.00864)
Number of physicians	0.402	0.320	0.586
	(1.375)	(1.254)	(1.116)
Pre-natal care	-0.0173	-0.0116	-0.0134
	(0.0218)	(0.0201)	(0.0179)
Log of GDP per capita	7.159***	6.420***	4.844***
	(2.506)	(2.123)	(1.592)
HIVAIDS	-7.306	-5.984	-3.309
	(5.132)	(4.436)	(3.456)
Governance	-1.084***	-1.064***	-0.461*
	(0.207)	(0.153)	(0.256)
Public*Governance	-0.0250***		
	(0.00632)		
Private*Governance		-0.0203***	
		(0.00603)	
External*Governance			-0.0311***
			(0.00820)
Constant	22.38	15.83	-2.266
	(35.32)	(31.49)	(24.72)
DIAGNOSTIC			
S stat	4.49	4.39	7.42
Prob.	0.877	0.884	0.593
AR(2)	0.579	0.666	0.945
Obs	665	665	665

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ represents significance level at 10%, 5% and 1%.
Source: Gamette (2020)

Models 1, 2 and 3 present the mediating effect of governance on the relationship between disaggregated components of health financing and infant mortality in SSA. The coefficients of all the interactive terms are statistically significant and negatively signed. In model 1, public health expenditure alone records -0.0427 and statistically significant at 1%. Intuitively, when SSA countries allocate US$ 1000 to healthcare, infant mortality reduces by 43 live births. The findings concurs that of Novignon & Novignon (2012) and Compa-Keyeke et al. (2013) that shows that public health expenditure has negative and statistical significant effect on infant mortality in SSA. In the same vein, model 1 shows that governance is 1% statistically significant and negatively signed (-1.084). This implies that when governance improves by 1 unit, infant mortality reduces by 1 infant. It is consistent with the conclusion reached by Lin et al. (2014) that governance improves health outcomes in 149 countries.

The synergy of public health expenditure and governance is statistically significant at 1% and negatively signed (-0.0250). This means that when public health expenditure increase by US$ 1000 combined with improved governance, infant mortality reduces by 25 infant births. As evident in the literature and chiefly elaborated by studies (Kraay, Kaufmann & Mastruzzi, 2004; Zoido-Lobatón, Kaufmann & Kraay, 2000) that well-governed public institutions serve as channels to ensure effective public service. Result from combined public health expenditure and governance yields a lower infant mortality reduction rate compared to public health financing alone. Intuitively, this implies the existing governance structures

defuse the effectiveness of public health expenditure in reducing infant mortality in SSA.

In model 2, the study concentrates on the confounding effect of private health expenditure and governance on infant mortality. Private health expenditure alone is statistically significant at 1% and negatively signed (-0.0545). Intuitively, when private health expenditure increases by US $1000, infant mortality reduces by 55 live infant births. This is consistent with the argument of Issa and Ouattara (2005) that private health inversely influences infant mortality. Governance alone is also statistically significant at 1% and negatively signed (-1.064). This suggests that when governance improves by 1 unit, infant mortality reduces by 1 surviving infant.

Moreover, the confounding effect of private health expenditure and governance is also infant mortality soothing (-0.0203) at 1% statistical significance level. When private health spending increases by US$ 1000 complemented by improved governance measures, infant mortality reduces by 20 infant live births. This finding is consistent with the conclusion reached by Sirag et al. (2017) that governance indicator makes private health expenditure effective in affecting health outcomes in 177 developed and developing countries. Despite the decline in infant mortality rate in the case of combined private health spending and governance, it is lower than when only private health expenditure exists. Intuitively, when private firms, households and individuals alone spend on health without the complement of governance measures, it reduces infant mortality by a greater margin compared to when private health expenditure combines with governance. It explains that

governance reduces the potency of private health expenditure in reducing infant mortality hence leading to a lower decline in infant mortality.

Model 3 also concentrates on the confounding effect of governance on the relationship between external health aid and infant mortality. External health aid alone is statistically significant at 1% and negatively signed (-0.0266).When SSA countries commit US$ 1000 of external funds alone on health, infant mortality reduces by 26 infant live births. This finding is in line with the argument of Mishra and Newhouse (2009) and Masud and Yontcheva (2005) which indicates that health aid has a negative effect on infant mortality in WHO countries. The result, however, contradicts the work of Williamson (2008) which indicates that health aid has no influence on infant mortality in high, medium and low-income economies.

Moreover, Governance independently is statistically significant at 1% and negatively signed (-0.461). The implication is that when governance improves by 1 unit, infant mortality reduces by 1 surviving infant. The coefficient of the joint external health aid and governance effect is statistically significant and negative signed (-0.0311), suggesting that where SSA countries commit external aid to health, governance matters in reducing infant mortality. This means that when SSA countries commit US$ 1000 of external aid to health combined with governance, infant mortality reduces by 31 infant live births. This conforms to findings by Doucouliagos, Hennessy and Mallick (2021) which indicates that infant mortality reduces on condition of good governance (government effectiveness and control of corruption) in 96 recipient countries.

Additionally, the synergy effect of external health aid and governance is more effective than the independent effect of external health aid on infant mortality. This is against the backdrop that external health aid comes with already established stringent measures hence fusing domestic governance measures with already established measures make combined external health aid more effective compared to independent effect of external health aid on infant mortality.

In all three models, female literacy rate, number of physicians and Gross Domestic Product per capita all had positive effects on infant mortality in SSA. These show counter intuitive results in relation to infant mortality. Female literacy level can rise however when females use this skill for searching for personal opportunities like jobs rather than use this skill to improve upon the means of catering for their child then infant mortality will continue to surge. Even though Gross Domestic Product can increase within the respective countries, specific country's efforts in committing financial resource to the health sector is woefully inadequate. This is evident in many SSA countries as most countries fail to commit 15% of Gross Domestic Product to the health sector. In the same vein, infant mortality can still increase when the number of physicians per 1000 population also increases. When physicians are available however not trained to handle infant health then infant deaths will continue to surge.

Table 7 also demonstrates the diagnoses for model 1, 2 and 3. For each of the models 1, 2 and 3, the probability value of the Sargan Statistics are 0.877, 0.884 and 0.593 respectively indicating insignificant results. This specifies that the instruments employed in all model are efficient. The same

models 1, 2 and 3 fail to reject the hypotheses that there is no serial correlation among the variables employed in the model.

Partial Effect Analysis

Table 8: Partial Effects

Health Financing Components	Public Health Expenditure	Private Health Expenditure	External Health Aid
Partial Effect (Disaggregated Health Financing)	-0.0427	-0.0259	-0.0266
Partial Effect (Governance)	-2.187	-1.8059	-0.7747

Source: Gamette (2020)

In analyzing the mediating effect, the study assess the partial effect of an independent variable on a dependent variable at the mean of an intervening variable. Based on this study, partial effect is analysed from two varied perspectives. The first perspective analyses the partial effect of each disaggregated component of health financing on infant mortality at the mean of governance. From model 1, the computed net effect of public health expenditure shows that a US$ 1 increase in public health expenditure causes infant mortality to reduce by 0.0427 at the mean of governance. Intuitively, this means that with US$1000 increase in public health expenditure, SSA countries' infant mortality reduces by 43 live infant births at the mean of governance. Similarly, in model 2, a US$1 increase in private health expenditure reduces infant mortality by 0.0259.at the mean of governance. The implication is that when private health expenditure increases by US$1000 at the mean of governance, SSA countries witness a reduction of 26 infant deaths. From the same net effect computations, a US$1 increase in external health aid leads to a reduction of 0.0266 in infant mortality at the mean of governance. This suggests that when SSA countries commit additional

US$1000 of external aid to healthcare, infant mortality reduces by 27 live infant births at the mean of governance.

The second perspective focuses on the partial effect of governance on infant mortality in SSA over the study period. From model 1, the computed net effect of governance shows that when governance improves by a unit infant mortality reduces by 2.187 at the mean of public health expenditure. This implies that when governance improves by a unit, infant mortality reduces by 2 live infant births at the mean of public health expenditure. Moreover, the computed net effect of governance in model 2 suggests that when governance improves by a unit, infant mortality reduces by 1.8059 at the mean of private health expenditure. Intuitively, when governance improves by a unit, 2 additional infants survive among 1000 live births at the mean of private health expenditure. Similarly, in model 3, when governance improves by a unit, infant mortality reduces by 0.7747 at the mean of external health aid. This implies when governance in SSA countries improves by a unit, there is an additional (1) infant who survives at the mean of external health aid.

From the above-mentioned results, the study concludes that governance has a partial negative and statistically significant effect on infant mortality, which is in consonance with the works of Lazarova (2006) & Lin et al. (2014) indicating that governance has negative effect on health outcomes. However, the implication is that SSA countries that witness improvement in governance is more geared towards public and private health investors than external partners. This result indicates that Governance might improve but when external partners have other sectors other than child health where they

concentrate their financial resources then external aid is unlikely to reduce infant mortality rate in SSA.

Results from Table 7 indicates that models 1, 2 and 3 records 0.935, 0.918 and 0.876 respectively indicating at 1% significance level, the lag effect of preceding infant mortality level affects current infant mortality levels across sub-regional groups as well as SSA in general.

Chapter Summary

This study aims at analyzing the effect of disaggregated components of health financing in SSA and across its sub-regional groups. The study also estimates the confounding effect of governance on the relationship between disaggregated components of health financing and infant mortality in SSA. Hence, three major hypotheses are tested using the panel dynamic Generalized Method of Moments (System-GMM). The purpose of the study is categorized into three:

The first objective looks at the relative effect of disaggregated components of health financing on infant mortality in SSA in table 3. From Table 3, the study rejects the hypothesis there is no significant relationship between disaggregated components of health financing and infant mortality in SSA countries. Each disaggregated components of health financing is statistically significance at 1% significance level.

The second objective shows in Table 4, which interrogates the comparative effect of disaggregated components of health financing (public health expenditure, private health expenditure and external health aid) on infant mortality (INF) across sub-regional groups in SSA region. The results also fails to reject the hypothesis there is no significant negative relationship

between disaggregated components of health financing and infant mortality across sub-regional groups in SSA countries at different significance levels (1%, 5% and 10%).

In addition to the above, Tables 6 and 7 indicates that the coefficients of each disaggregated health financing component with governance moderating as well as the test of significance of each disaggregated health financing component with governance serving as a mediator are all statistically significant which affect infant mortality in Sub-Sahara Africa (SSA). All the interacted terms are statistically significant at 1% significance level each. Therefore, the study fails to reject the hypothesis that there is no confounding effect of governance on the relationship between disaggregated health financing and infant mortality in Sub-Sahara Africa (SSA).

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

A summary of the study is presented in this chapter. In addition, this chapter present conclusions and policy recommendations based on the study's results, as well as and suggesting areas for future research on the subject.

Summary

As a core objective, the study seeks to analyse health financing, governance and infant mortality in Sub Saharan Africa (SSA) over the period 2000 to 2016. Specifically, the study sought to estimate both the differential and comparative effects of disaggregated components of health financing (public, private and external health aid) on infant mortality in SSA and SSA sub-regional groups respectively. In addition, the study examines the confounding effect of governance on the relationship between each of the disaggregated components of health financing (public, private and external health aid) and infant mortality in SSA.

The study employs an adapted model from Mosley and Chen (1984) analytical framework for analyzing infant survival. In this model, disaggregated component of health financing is the independent variable, governance is the intervening variable and infant mortality is the dependent variable. Based on Globerman and Shapiro (2002) and Buchanan et al. (2012), the study uses the Principal Component Analysis (PCA) to compute a composite governance index from three governance indicators (government effectiveness, control of corruption and regulatory quality). Moreover, the

model considers some socio-economic variables that can influence on infant mortality.

In view of this, the study adopts the Generalized Method of Moment (System-GMM) developed by Arellano and Bond (1991) to analyse the three aforementioned objectives in dynamic parameters due to endogeneity issues associated with infant mortality.

The study finds that all disaggregated health financing components negatively and significantly affect infant mortality. Thus, increasing public, private and external health expenditures reduces the number infants that die among 1000 live births. This is because when governments, private individuals and external donor partners increase their financial allocation to child health in SSA, the number of infants that die reduces. However, external health aid is the most effective component of health financing in SSA. This is because donor partners monitor health-spending activities in SSA countries as well as target specific areas of child health like vaccination, immunization, delivery of insecticides treated net and others.

Even though Central African countries increase both public and private spending on health, infant mortality is still high. This is because countries located in the Central part of SSA are more vulnerable to hunger and diseases as well as their health spending might be highly directed towards other areas like health infrastructure, remuneration of staffs and others rather than child health. Even though, both government and private individuals increase health spending on child health, infants' vulnerability makes them more susceptible to death than adults in the society.

External health aid is the most effective component among the three disaggregated health-financing mechanisms in reducing infant mortality in SSA. Moreover, external health expenditure increases infant mortality in West Africa. The underlying reason is that though West African countries witness increasing flow of external funds; stringent measures accompanying these funds mostly do not correspond to infants' health needs in SSA countries.

In the presence of effective governance measures, public health expenditure is the most effective health financing mechanism in reducing infant mortality. This is because increase in government's commitment to child health, strong measures aimed at curbing corrupt practices and better policies help reduce infant mortality.

However, improved governance in the presence of low health expenditure results in minimal reduction in infant mortality. When there is an increase in governments' commitment in taking steps to curb corrupt practices and implement health legislations without the necessary health expenditures will result in a reduction in infant mortality but not to the optimal levels.

Conclusions

The study concludes that an increase in each disaggregated health financing component serves as a catalyst for decline in infant mortality in SSA countries.

The study also concludes that public and private health expenditures reduce infant mortality in East Africa, West Africa and South Africa. Moreover, external health expenditure reduces infant mortality in East Africa, Central Africa and South Africa. However, public and private health expenditures lead to increase in infant mortality in Central Africa. External

health expenditure leads to a rise in infant mortality in West Africa due to a mismatch between SSA health needs and donor partners' countries' investment priorities.

There are regional differences on the effects of disaggregated components of health financing on infant mortality across SSA sub-regional groups. Infant mortality in some sub-regions responds greatly to disaggregated components of health financing whiles other sub-regions respond poorly to the health financing components. The study also suggests a complementary relationship between disaggregated health financing mechanisms and governance for access to quality infant health care in SSA countries.

The study indicates that governance makes an increase in disaggregated health financing more efficient in reducing infant mortality in SSA. It is seen from the study that health financing reduces infant mortality in SSA. Moreover, the intervention of governance makes health financing more effectual in abating infant mortality. Specifically, improved governance system integrated with increasing public and private health expenditures yield the desired reduction in infant mortality in SSA. This happens when appropriate institutions and efficient policies are implemented. Challenges such as offering of bribes to health professionals to circumvent funds, low government commitment and poor regulatory measures in the health sector undermine the efficacy of public and private health expenditures. On the contrary, external health expenditure integrated with governance result in more reduction in infant deaths due to stringent measures attached to external aid.

Recommendations

Drawing from the findings and conclusions of this study, the following recommendations are suggested:

Ministries of Health in respective SSA countries should strengthen partnership with foreign donors in the fight against infant mortality. This will help increase the level of global partnership between SSA countries and their foreign partners in reducing infant mortality.

Regional and sub-regional health organisations such as the Africa Health Organisation (AHO) and West Africa Health Organisation (WAHO) should collaborate with respective SSA countries' health ministries to direct health funds towards meeting the SSA region and each sub-region's specific infant health needs. This is because each SSA sub-region has idiosyncratic infant healthcare needs hence the need to channel components of health financing towards specific health care of the sub-region.

Auditors in Ministries of Health in respective SSA countries should strengthen regulations that guide health expenditure to have higher reduction in infant mortality level. This is because enhanced regulations coupled with increasing disaggregated components of health expenditure results in higher reduction in infant mortality compared to increasing health expenditure alone.

Limitations

The failure to obtain sufficiently uses of cross - sectional units and data sets for the research is one of the study's key limitations, so only a representative of 42 countries is considered. In fact, some of the predictors for some countries have redundant data. This can restrict the analysis because those values might have an impact on the outcome.

The study did not consider dissimilar characteristics of the sub-sample which needs to be included in the study for a heterogeneous panel analysis. For example, due to the small sample size, the study could not base its health expenditure analysis on resource endowment of the considered countries. Irrespective of the above-cited limitations, the findings of this study are still imperative.

The study did not consider other three governance pointers (voice and accountability, rule of law and political stability). This could limit the effect of undermine measurement of governance hence affecting the role of governance in the relationship between disaggregate health financing components and infant mortality in SSA.

Suggestions for future research

While it is important to know the impact of health financing, governance and infant mortality from sub-Saharan Africa. There is the need for a country specific study so as to bring to the fore the impacts of governance and health financing on infant mortality at country level in order to shed light on effective strategies to foil the loss of future human resources.

The use of three governance indicators provided a partial view of how governance could affect the relationship between disaggregated health financing components and infant mortality in SSA. Future studies can use all the six governance indicators to fully assess the effect of governance on the relationship between disaggregated health financing and infant mortality in SSA.

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APPENDICES

APPENDIX A: Correlation Matrix of variables

Variable	INF	PBPER	PRPER	HADPER	IMM	IWS	ISF	FLT	FERT	NPYS	PRN	PGDP	HIVAIDS	GOV
INF	1													
PBPER	-0.5247	1												
PRPER	-0.3193	0.5834	1											
HADPER	-0.3254	0.3155	0.2087	1										
IMM	-0.6489	0.2854	0.0121	0.3459	1									
IWS	-0.6013	0.6336	0.5458	0.244	0.4184	1								
ISF	-0.5207	0.7031	0.566	0.145	0.3224	0.6933	1							
FLT	-0.2128	0.0781	0.0928	0.1979	0.0968	0.1061	0.0673	1						
FERT	0.6911	-0.6898	-0.532	-0.295	-0.5226	-0.7486	-0.6603	-0.1183	1					
NPYS	-0.3551	0.1378	0.1679	0.328	0.2123	0.1662	0.1061	0.3824	-0.1841	1				
PRN	-0.2842	0.089	0.1228	0.2293	0.2104	0.1291	0.0825	0.3999	-0.1401	0.4703	1			
PGDP	-0.549	0.7424	0.7346	0.2735	0.1667	0.71	0.7292	0.157	-0.6989	0.2741	0.2138	1		
HIVAIDS	-0.0275	0.015	0.0392	0.0808	0.1187	-0.0084	-0.0037	-0.3482	0.0186	0.0553	0.2694	0.0782	1	
GOV	-0.4679	0.4382	0.4116	0.2284	0.3933	0.4644	0.4346	0.0359	-0.4891	-0.0065	-0.0077	0.3594	-0.0365	1

APPENDIX B: PRINCIPAL COMPONENT ANALYSIS

Rotation

Variable	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.64189	2.36626	0.8806	0.8806
Comp2	0.275624	0.193137	0.0919	0.9725
Comp3	0.0824875		0.0275	1.0000

Principal Components Rotation

Variable	Variance	Difference	Proportion	Cumulative
Comp1	1.00002	5.42107e-06	0.3333	0.3333
Comp2	1.00001	0.0000448907	0.3333	0.6667
Comp3	0.999968		0.3333	1.0000

Rotated Components

Variable	Comp1	Comp2	Comp3	Unexplained
CRPT	-0.0000	1.0000	-0.0000	0
GVT	0.0000	0.0000	1.0000	0
RQ	1.0000	0.0000	-0.0000	0

Component rotation matrix

	Comp1	Comp2	Comp3
Comp1	0.5686	0.5642	0.5986
Comp2	-0.6833	0.7292	-0.0384
Comp3	0.4581	0.3872	-0.8001

APPENDIX C: PARTIAL EFFECT ANALYSIS

In this appendix, the study demonstrates how the partial effect of both disaggregated health financing and governance are calculated.

1. Partial Effect of Disaggregated Components of Health Financing

$$INF = \alpha_i + B_1 PBPER + B_2 GOV + B_3 PBPER^* GOV$$

$$\frac{dINF}{dPBPER} = B_1 + B_3 GOV$$

$$= -0.0427 + 0.0250 (-5.67E-10) = -0.0427$$

A US$ 1,000 increase in public health expenditure decreases infant mortality by 43 infant deaths at the mean of governance (GOV).

$$INF = \alpha_i + B_1 PRPER + B_2 GOV + B_3 PRPER^* GOV$$

$$\frac{dINF}{dPRPER} = B_1 + B_3 GOV$$

$$= -0.0259 + 0.0203 (-5.67E-10) = -0.0259$$

A US$ 1,000 increase in private health expenditure decreases infant mortality by 26 infant deaths at the mean of governance (GOV).

$$INF = \alpha_i + B_1 HADPER + B_2 GOV + B_3 HADPER^* GOV$$

$$\frac{dINF}{dHADPER} = B_1 + B_3 GOV$$

$$= -0.0266 + 0.0311 (-5.67E-10) = -0.0266$$

A US$ 1,000 increase in external health aid decreases infant mortality by 27 infant deaths at the mean of governance (GOV).

2. Partial Effect of Governance

$INF = \alpha_i + B_1 PBPER + B_2 GOV + B_3 PBPER * GOV$

$\frac{dINF}{dGOV} = B_2 + B_3 PBPER$

$= -1.084 + 0.0250 (44.12907) = -2.187$

An improvement in governance index leads to a reduction in 2 infant deaths at the mean public health expenditure (PBPER).

$INF = \alpha_i + B_1 PRPER + B_2 GOV + B_3 PRPER * GOV$

$\frac{dINF}{dGOV} = B_2 + B_3 PRPER$

$= -1.064 + 0.0203 (36.54711) = -1.8059$

An improvement in governance index leads to a reduction in 2 infant death at the mean private health expenditure (PRPER).

$INF = \alpha_i + B_1 HADPER + B_2 GOV + B_3 HADPER * GOV$

$\frac{dINF}{dGOV} = B_2 + B_3 HADPER$

$= -0.461 + 0.0311(10.08746) = -0.7747$

An improvement in governance index leads to a reduction in 1 infant death at the mean external health aid (HADPER).

APPENDIX C: TESTING OF SIGNIFICANCE

Hypothesis 1

H_0 : PBPER=PRPER=HADPER = 0

F (13, 651) = 9435.97

Prob > F = 0.000***

Hypothesis 2

East Africa

H_0 : PBPER=PRPER=HADPER = 0

F (13, 109) = 5025.07

Prob > F = 0.000***

Central Africa

H_0 : PBPER=PRPER=HADPER = 0

F (13, 128) = 3572.56

Prob > F = 0.000***

West Africa

H_0 : PBPER=PRPER=HADPER = 0

F (13, 226) = 2222.80

Prob > F = 0.000***

South Africa

H_0 : PBPER=PRPER=HADPER = 0

F (13, 146) = 1641.87

Prob > F = 0.000***

Hypothesis 3

Interaction between Public health expenditure and Governance

H_0 : PBPER*GOV = 0

F (15, 144) = 2151.30

Prob > F = 0.000***

Interaction between Private Health Expenditure and Governance

H_0 : PRPER*GOV = 0

F (15, 144) = 1454.06

Prob > F = 0.000***

Interaction between External Health Aid and Governance

H_0 : HADPER*GOV = 0

F (15, 144) = 1828.22

Prob > F = 0.000***

APPENDIX D: LIST OF COUNTRIES

Angola
Benin
Botswana
Burkina Faso
Burundi
Cameroon
Cape Verde
Central African Republic
Chad
Comoros
Congo
Democratic Republic
Cote D'Ivoire
Djibouti
Equatorial Guinea
Eritrea
Ethiopia
Gabon
The Gambia
Ghana
Guinea
Guinea- Bissau
Kenya
Lesotho
Liberia
Madagascar
Malawi
Mali
Mauritius
Mozambique
Namibia
Niger
Nigeria
Rwanda
Sao Tome and Principe
Senegal
Seychelles
Sierra Leone
South Africa
Swaziland
Tanzania
Togo
Uganda
Zambia