HEALTH CARE SPENDING AND HEALTH OUTCOMES IN SUB-SAHARAN AFRICA: EVIDENCE FROM DYNAMIC PANEL

SCHOLASTICA ACHIENG ODHIAMBO

Thesis Submitted to the School of Economics in Partial Fulfilment of the Requirements for the Degree of Doctor of Philosophy in Economics of the University of Nairobi

2014

DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

Signature:……..……Date…….

Scholastica Achieng Odhiambo

APPROVAL

This thesis has been submitted for examination with our approval as university supervisors.

Signature:…….Date…….

Dr. Anthony Wambugu

Signature:…… Date……

Prof. Tabitha Kiriti-Ng'ang'a

DEDICATION

This work is dedicated to my sons

John Kennedy Odhiambo, Andrew Stefan Oray and Late Master Kristian Owino

ACKNOWLEDGEMENT

My sincere gratitude goes to my distinguished supervisors, Dr. Anthony Wambugu and Prof. Tabitha Kiriti-Ng'ang'a both of the School of Economics, University of Nairobi. The valuable and enriching comments and suggestions from my supervisors have enabled and facilitated me to write this extensive work. Many thanks to the administration of the School of Economics, University of Nairobi and the African Economic Research Consortium for believing in my competence by awarding me the Doctorate of Philosophy in Economics scholarship. My involvement in the Collaborative PhD Programme tenable at both the University of Dar es Salaam and University of Nairobi has improved both my academic and research capacity in economics substantially. Many accolades also go to my lecturers at the University of Dar es Salaam and Joint Facility for Electives at the Kenya School of Monetary Studies in 2011. Many thanks also go to the administration of Maseno University and the School of Business and Economics for granting me adequate period for study leave to enable me undertake my studies.

My humble gratitude goes to my sons John Kennedy and Andrew Stefan whose resilience and strength during my many periods of absence due to my studies helped me to go on. My sincere gratitude also goes to my tireless mentors Prof. Rosemary Atieno of the Institute for Development Studies, University of Nairobi and Dr. Seth Gor of the School of Economics, University of Nairobi. My sincere acknowledgement to my fellow CPP Pan African students who made the process of learning challenging and bearable.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATION AND ACRONYMS

2SLS	Two Stage Least Squares
AfDB	African Development Bank
AIDS	Acquired Immune Deficiency Syndrome
ART	Anti-Retroviral Therapy
AU	Africa Union
CGD	Centre for Global Development
CPI	Corruption Perception Index
DPT	Diptheria, Pertussis and Tetanus
EAC	East Africa Community
EAHP	East Africa Health Platform
FE	Fixed Effects
FGLS	Feasible Generalised Least Squares
GDP	Gross Domestic Product
GMM	General Method of Moments
GMM-H2SLS	General Method of Moments- Heteroscedastic Two Stage Least Squares
GMM-HOLS	General Method of Moments- Heteroscedastic Ordinary Least Squares
GMM-IV	General Methods of Moment-Instrumental Variables
GNI	Gross National Income
HDI	Human Development Index
HIPC	Heavily Indebted Poor Countries
HIV	Human Immuno-Deficiency Virus
HNP	Health Nutrition and Population
HSS	Health System Series
IMF	International Monetary Fund
ITNs	Insecticide Treated Nets
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
LDPD	Linear Dynamic Panel Data Model
MDGs	Millennium Development Goals
MIMIC	Multiple Indicators Multiple Causes

NBER	National Bureau of Economic Research
OAU	Organization of African Unity
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Squares
PMTCT	Prevention of Mother- to -Child Transmission
PPP	Purchasing Power Parity
R2SLS	Robust Two Stage Least Squares
RE	Random Effects
ROLS	Robust Ordinary Least Squares
SADC	Southern Africa Development Community
SSA	Sub-Saharan Africa
UN DESA	United Nations Department of Economics and Social Affairs
UNAIDS	The Joint United Nations Programme on HIV/AIDS
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UN-Inter Agency	United Nations Inter Agency
UNPD	United Nations Population Division
USD	United States Dollars
WAHO	Western African Health Organization
WDI	World Development Indicators
WHO	World Health Organization
WTSLS	Weighted Two Stage Least Squares

ABSTRACT

This thesis addresses two issues. First, to address the problem of underfunding of health systems in SSA the Abuja Declaration of 2001 set a target to allocate 15% of a country's budget to public health expenditure. However there is no empirical evidence on whether SSA countries are converging or diverging from the target and whether there is significant effect of the Abuja instrument on other health expenditure indicators. The second issue concerns health expenditure and health outcomes. Although increased health expenditure has been widely advocated as a mean to improve health status of the SSA population, empirical evidence to support this is scarce and contains mixed findings. A key omission in this literature is lack of consideration of the institutional environment in which health spending is undertaken. The primary objective of this thesis is to examine the behaviour of health expenditure and its effect on health outcomes in SSA. First, the thesis tested convergence of health expenditure in SSA in the post Abuja declaration period. Second, the effects of health expenditure, level of corruption and their interaction on child health and adult health were estimated. The linear dynamic panel model was estimated by GMM-IV method on a panel of 41 SSA countries for the period 2000 to 2011. The thesis provides two sets of econometric evidence. First, the empirical results show evidence of absolute and conditional convergence of health expenditure in SSA. Differences in real income per capita aided convergence of public health expenditure as a percent of government expenditure and private health expenditure as a percent of total health expenditure but contributed to divergence of real per capita health expenditure, total health expenditure as a percent of GDP and public health expenditure as a percent of total health expenditure. Variations in external funding (donor) for health care caused divergence in real per capita health expenditure, total health expenditure as a percent of GDP but aided the convergence of public health expenditure as a percent of total health expenditure. Non-HIPC debt relief benefitting countries were likely to diverge from equilibrium of total health expenditure as a percent of GDP, public health expenditure as percent of government expenditure, real per capita health expenditure and private health expenditure as a percent of total health expenditure except for public health expenditure as a percent of total health expenditure. The Abuja policy instrument (public health expenditure as a percent of government) reduced the rate of convergence of other health expenditure measures except for private health expenditure as percent of total health expenditure which was increasing in the study. Second, the study results indicate that health expenditure significantly reduces under-five mortality and adult mortality in SSA countries. Public

health expenditures have significant negative effect on under-five mortality and positive effect on adult mortality. The converse was found for private health expenditures. The quality of governance proxied by corruption perception index had an impact on effectiveness of health expenditure in reducing under-five and adult mortality. Public health expenditure was more effective in reducing under-five mortality in low corruption environment than in highly corrupt environment. Private health expenditure was more effective in reducing adult mortality in low corruption situation than in high corruption environment. There also exist regional variations in effectiveness of health expenditure and governance on under-five and adult mortality. In addition to health expenditure, real income per capita, measles immunization rates and female labour force participation have significant negative effect on under-five mortality. On the other hand, total fertility rates, female literacy, HIV prevalence rates and ethnic fragmentation increased under-five mortality in SSA. Real income per capita and adult literacy reduced adult mortality while, HIV prevalence rates and ethnic fragmentation increased adult mortality. All the results exhibited significant differences between Eastern Africa, Western Africa, Central Africa and Southern Africa. The implications of the findings are: First, continued reliance on donor funding for health systems directly or through debt relief is likely to delay convergence to Abuja target. SSA governments should formulate sustainable health financing mechanisms that reduce dependency on external source for health system support in the long run. Second, for increased health expenditure to yield greater reduction in mortality it should be accompanied by improvements in governance through reduced levels of corruption. This points to the importance of enhancing anti-corruption efforts to improve effectiveness of health expenditure in improving health outcomes in SSA. Third, the regional differences in effectiveness of health expenditure, provides an impetus to formulate joint coordinated policies to regulate institutional environment for SSA health systems. This is likely to improve implementation of common health agendas such as, Abuja Declaration 2001 and the Ouagadougou Primary Health Care Framework of 2008 within SSA countries. Policies to increase real income per capita, measles immunization, female labour force participation and ethnic cohesion and policies to lower fertility rates and HIV prevalence rates would reduce under-five mortality rates. Adult mortality could be reduced by policies that increase ethnic cohesion, real income per capita and adult literacy.

Key words: SSA, Convergence, Health Expenditure, Corruption, Dynamic Panel Model

CHAPTER ONE
INTRODUCTION

1. Background

Human capital development plays an important role in enhancing economic growth and poverty alleviation prospects in both developed and developing regions (Tatoğlu, 2011; Allahdadi and Aref, 2011; Asaju, 2012; Winters and Chiodi, 2011). Human capital stock is increased through investments in health, education and nutrition (Haldar, 2008; Tatoğlu, 2011; Strauss and Thomas, 1995; World Economic Forum, 2013). Lopez-Casasnova, et al. (2007) suggest that an antidote for underdevelopment and stagnation of an economy would be a labour force which has good education and health status.

Investment in health improves human capital and human capital enhances labour productivity which is a source of economic growth (Bloom and Canning, 2000; 2005). High levels of health outcomes are associated with high levels of investment in education and labour earnings, longer life expectancy and high levels of increased long-term savings, which are a prerequisite for economic growth (Bhargava, et al., 2001; Bloom, et al., 2004; Bleakley, 2010).

However, levels of health outcomes in Sub-Saharan Africa (SSA) are relatively low compared to other regions of the world (World Bank, 2013; UNICEF, et al., 2012). A range of health outcomes are used in the literature as a proxy for health human capital (Tatoğlu, 2011). They include health expenditure (public, private (out-of-pocket and private health insurance)), prevalence and incidences of morbidity (from diseases such as Malaria, Tuberculosis and HIV/AIDS), incidences of mortalities (infant, under-five, adult and maternal), nutritional based and health interventions (such as treatment therapies, nutritional supplements and immunization/vaccinations) (Schneider, 2001; WHO, 1998; Chatterji, et al., 2002). Mortality rates among children and adults are largely

influenced by epidemiological characteristics of a given geographical region. According to Lopez, et al. (2006) an epidemiological profile is characterized by communicable diseases, non communicable diseases and injuries. The main communicable diseases that have increased mortality rates in SSA include; Human Immuno-Deficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS), malaria, measles and tuberculosis. There is also rising concern about increasing morbidity in SSA from non-communicable diseases such as cancer, cardiovascular diseases, diabetes and asthma.

In 2011, about 50.9% of world under-five mortality were reported in SSA compared to South Asia (33.6%), Middle East and North Africa (3.7%), Latin America and Caribbean (3%), East Asia and Pacific (8.2%) and North America, Europe and Central Asia (0.6%) (World Bank, 2013)[1]. SSA also recorded about 20% of the world adult mortality. Other regions which reported high adult mortality include South Asia (25.1%) and East Asia and Pacific (21.8%). Latin America, Caribbean, Middle East and North America had the lowest adult mortality in the same period at 6.5% and 3.6% respectively. These statistics imply that SSA countries need to reduce under-five and adult mortality to catch up with other regions of the world.

Consequently, the challenge to the SSA governments and development partners is how to effectively improve health outcomes especially reducing mortality rates. To this end, since the year 2000, more effort has been directed towards formulating health policies and designing interventions to mitigate against poor health outcomes in the sub-continent. The global and regional health policies have included; the Millennium Development Goals (MDGs)[2], the Global Fund

[1]The statistics for calculation of the regional percentages of under-five mortality are derived from the World Development Indicators- Crude birth rates, total population and under-five-mortality rates.
[2]Focused on improvement of child and maternal health, reduction of HIV prevalence and environmental health.

initiative[3], the Abuja Declaration on public health spending by African countries[4], global immunization campaigns and health systems strengthening initiatives[5] (United Nations, 2011; OAU, 2001; Global Fund, 2011; Wolfson, et al., 2008; Health System 20/20, 2012). Since the year 2000 the health outcomes in SSA have improved, but further improvement is required (Bryan, et al., 2010; United Nations, 2011).

The key policy pursued by SSA governments and development partners to improve health outcomes is increasing public health spending (OAU, 2001; Global Fund, 2011). Health spending can influence health outcomes if it increases access to affordable health care and other health improving services. Although public health spending has received most attention, it is important to note that, health systems in developing countries including SSA are financed through a mixture of public, private and donor sources (Islam, 2007). According to World Bank (2011) in 2009 SSA health expenditure per capita (PPP, Constant 2005, and International) was about US$158.60; private health expenditure was 3.7% of GDP; public health expenditure was 2.9 % of GDP; and total health expenditure was 6.6% of GDP.

The average per capita total health spending (US$158.60) in SSA exceeds minimum amount recommended to enable low-income countries to provide a basic package of essential health services by the Commission on Macroeconomics and Health (2001) - US$ 34 and World Health Organization (2009)-US$54. It seems that part of the high per capita health expenditure is private health expenditure (54.9% of total health expenditure). Public spending is still low as most countries have not met the Abuja Declaration target to allocate 15% of government expenditure to

[3]Focused on the interventions to reduce HIV/AIDs, Malaria and Tuberculosis by providing more funds to the governments for health service delivery.
[4]Focused on increasing public health spending to 15% of the African Government s' annual budget.
[5]Health system strengthening is embedded in six pillars; i) leadership and governance; ii) health financing; iii) human resource for health; iv) health service delivery; v) medical products, vaccines and technologies; and vi) health information systems (Health Systems 20/20, 2012).

health (Tandon and Cashin, 2010). A number of factors may explain inadequate health care spending in SSA (Gold and Ejughemre, 2013). These range from unfavourable economic conditions, low quality of governance (for example, high levels of corruption) and to increasing disease burden (for example, HIV/AIDS pandemic). Low health spending is a concern as it can lead to shortage of health workers; drugs and medical supplies; low wages and salaries and non-payment to health workers; low quality of health care; and inequitable health care service delivery (Vian and Nordberg, 2008; World Health Organization, 2006; Wagstaff and Claeson, 2004).

The failure to attain the Abuja target of 15% of government expenditure to health can be attributed to lack of commitment and inconsistencies in implementation of Abuja Declaration (Tandon and Cashin, 2010; World Health Organization, 2011a). Several countries have either stopped pursuing the Abuja target or are not implementing it fully (World Bank, 2013). This raises the question of whether SSA countries are converging towards higher health expenditure as envisaged in the Abuja Declaration target.

Another factor that appears to matter for cross country differences in health outcomes is quality of governance (Rajkumar and Swaroop, 2008; Yaqub et al., 2012; Gupta et al., 2000). Governance encompasses; voice and accountability; political stability and lack of violence; government effectiveness; government regulations; rule of law; and control of corruption (Kaufman et al., 2005; Lewis, 2006a (Page.7)). Corruption is a major problem around the world. About 69% of 177 countries globally scored below 50% in Corruption Perception Index (Transparency International, 2013). According to Lewis (2006a) corruption in the health sector is manifested through staff absenteeism, purchase of public positions, drug supply management and leakages, in-kind supplies, kickbacks and bribery in procurement, leakages of public funds and informal payments. Vian and Nordberg (2008) noted that incidences of corruption in the health sector reduce effective resources available for health services delivery. This may result in low quality of health services,

lower equity and effectiveness of health care services and decline in the volume of health services and rise in the cost of providing them.

Control of corruption is a challenge in SSA. Transparency International (2010) estimates that corruption reduces basic services financing in Africa by 20-30%. Subsequently, 90% of SSA recorded corruption index score of below 50%. Additionally, corruption is perceived as a tax which adds on to the overall cost of development projects by government and private sector. The average Transparency International Corruption Perception Index for SSA was 3.0 for the period 2000- 2009 (World Bank, 2011), on a scale of 0 (high corruption) to 10 (low corruption).

Increased public spending on health may not yield better health outcomes in the presence of high corruption levels. Thus the debate on effects of corruption and other governance indicators on health outcomes has recently shifted to its interaction with health expenditure. There is emerging evidence that effect of health care spending on health outcomes is moderated by quality of governance (Rajkumar and Swaroop, 2008; Yaqub, et al., 2012; Hu and Mendoza, 2013). The evidence indicates that reduction in corruption levels may lead to better health outcomes through its interaction with health spending.

The effect of public health spending on health outcomes may differ within SSA. Thus regional variations in effectiveness of health expenditure given the regional heterogeneity and differences in levels of corruption is a crucial area for new policy debate (Hopkins, 2010). The four sub-regions of SSA; Eastern, Central, Southern and Western Africa have regional affiliations which are likely to have quality health service delivery and health outcomes improvement agenda in their geographical boundaries. For instance, East Africa Community (EAC) through East Africa Health Platform (EAHP) develops joint health policies for the region (EAHP, 2013). Southern Africa Development Community (SADC) signed a protocol on health in 1999, which accounted for health policies within the region (SADC, 1999) and Economic Organization of Western African States

(ECOWAS) through West African Health Organization (WAHO) design and deliberate on health policies for the region (WAHO, 2013).

1.1 Statement of the Problem

Since the year 2000, SSA countries and development partners have initiated health care interventions and policies to improve health outcomes (UN, 2000; OAU, 2001; Global Fund, 2011). As a result morbidity and mortality rates among children and adults have declined (UN Inter-Agency, 2012; UNDESA, 2011; UNAIDS, 2012; WHO, et al., 2012). Despite the improvement in health outcomes, morbidity and mortality in SSA are high compared to other regions of the world (World Health Organization, 2012a).

Increasing public health expenditure is one of the options pursued to attain better health outcomes in Sub-Saharan Africa (Anyanwu and Erhijakpor, 2007; Yaqub, et al., 2012). In particular, under the Abuja Declaration of 2001 SSA countries committed to increase public health expenditure to 15% of total government expenditure. But very few have attained the target (Tandon and Cashin, 2010; World Health Organization, 2011a). Consequently, a key issue in health expenditure debate, is whether countries are converging or diverging to the Abuja declaration target (Tandon and Cashin, 2010; World Health Organization, 2011a). Despite this there is no study focusing on convergence of health expenditure for SSA. Most studies on convergence of health expenditure have focused on European Union (for example, Hitiris and Nixon, 2001; Kerem, et al., 2008; Lau and Fung, 2013), OECD (for example Narayan, 2007; Panopoulous and Pantelidis, 2012) and USA (Wang, 2009).

Although, inadequate health expenditure in SSA may explain the poor health outcomes, increased expenditure may not lead to better health outcomes if the institutional set up or environment is not functioning well. Some authors point out that diminished effectiveness of health expenditure rather than low expenditure maybe an obstacle to better health outcomes in SSA (Dodd, et al., 2007;

Gottret and Schieber, 2006). One of the key institutional capacity failures that can compromise the effectiveness of health spending is high level of corruption (Rajkumar and Swaroop, 2008; Yaqub, et al., 2012). Consequently, resources allocated to the health sector are partly wasted, leading to low quality health service delivery and poor health outcomes. An emerging literature argues that health expenditure may be ineffective in improving health outcomes due to poor governance (Hu and Mendoza, 2013; Rajkumar and Swaroop, 2008; Yaqub, et al, 2008). However, these studies are also inconclusive and there is little research on the issue for SSA. The existing studies on the direct link between health expenditure and health outcomes contains mixed results (Anyanwu and Erhijakpor, 2007; Novignon, et al., 2012; Farag, et al., 2013; Filmer and Pritchett, 1999; Gupta, et al., 1999; Or, 2000). Further, dearth in literature in regional heterogeneity in SSA in the effectiveness of health expenditure and governance on health outcomes is an issue of concern for common health agendas and policies implementation in SSA.

This thesis attempts to answer three questions. First, have health expenditures in SSA converged or diverged in the post Abuja declaration period? Second, how does health expenditure affect under-five mortality in SSA and what is the impact of corruption on the effectiveness of health expenditure on under-five mortality in SSA? Third, does health expenditure affect adult mortality in SSA, and how does the level of corruption influence the effect of health expenditure on adult mortality in SSA?

1.2 Objectives of the Thesis

The main objective of this thesis is to examine the behaviour of health expenditure and the relationship between health expenditure and health outcomes in Sub-Saharan Africa. The specific objectives of this thesis are:

a) To test convergence of health expenditure in Sub-Saharan Africa in the post Abuja declaration period.

b) To estimate the effect of health expenditure, level of corruption and their interaction on under-five mortality rates in SSA and its sub-regions.
c) To estimate the effect of health expenditure, level of corruption and their interaction on adult mortality rate in SSA and its sub-regions.

1.3 Contribution of the Thesis

This thesis makes several contributions to the literature on health expenditure and health outcomes. First, the thesis examines the impact of health expenditure on adult mortality as a measure of premature mortality among the persons aged 15 to 60 years. This health outcome has not been considered in empirical literature on this topic on SSA. Previous studies of the relationship between health expenditure and health outcomes in SSA (for instance, Anyanwu and Erhijakpor, 2007; Bokhari, et al., 2007) focused on infant mortality, under-five mortality rates, maternal mortality rates and life expectancy. Auster, et al. (1969) noted that adult mortality is objectively derived, more accurate than the other measures, it is readily available and is accepted universally. Saikia and Bhat (2008) argued that high adult mortality may cause shortfall in labour force which can affect economic growth, biological reproduction and support to younger and older population.

Second, the thesis examines the impact of corruption on health outcomes. It also examines how corruption affects the relationship between health expenditure and health outcomes. Only a handful of studies in developing countries have examined this issue, despite widespread problem of corruption. The thesis attempts to quantify the role of corruption in poor health outcomes. Although, the corruption measure used in the study is an economy aggregate in nature and it is not health sector specific. Transparency International corruption perception index (TICPI) is a crosscutting measures of corruption and to some extent can be applied to health sector. This is because corruption in the health sector is characterised by bribery, embezzlement, in-kind supplies,

kick-backs and purchasing of public positions (Lewis, 2006a) which are covered in the premise of TICPI.

Third, the few existing studies for SSA focus on SSA as a homogeneous region. This thesis examines regional differences in the effect of health expenditure and corruption on health outcomes. In particular, it tests whether there are significant differences between Eastern Africa, Western Africa, Central Africa and Southern Africa in the effect of health expenditure on under-five mortality rate and adult mortality. The regions are based on United Nations classification.

The fourth contribution of this thesis is that it examines the impact of public and private health expenditure on health outcomes of the two components of spending. In 2011, public health expenditure as a share of total health expenditure was 45.1% and private health expenditure as a percent of total health expenditure was 54.9% in SSA. However, with the exception of Novignon, et al. (2012) who used standard panel data estimator, the studies on impact of public health expenditure relative to private health expenditure are rare in literature. Moreover, the dynamics are typically ignored.

Another contribution of this thesis is that it investigates for the first time and with dynamic panel whether health expenditure across SSA countries has converged or diverged since the Abuja declaration of 2001. The declaration envisaged a development where SSA countries would converge toward 15% of government expenditure being allocated to health.

Empirical evidence about convergence in health expenditure is useful to promote shared health care strategies and promote better health outcomes across countries or regions (Wang, 2009). The Abuja declaration of 2001 (OAU, 2001) and the Ouagadougou Framework on primary health care and health systems in Africa (Barry, et al., 2010) indicate that SSA countries have signalled willingness for closer links on health issues as indicated by two region-wide health policies geared

toward better health service delivery and health outcomes across the region. As of 2010, most SSA countries had not met the Abuja declaration target (Tandon and Cashin, 2010; World Health Organization, 2011a). This has raised policy concern about financing of health care. However the Abuja policy instruments may have affected other health expenditure components. This thesis provides evidence on this issue. Furthermore, during the post Abuja declaration period donor aid to health sector in SSA increased and some SSA countries benefitted from HIPC debt relief (with its health financing condition). So, this thesis provides evidence of health expenditure convergence in SSA conditional on the two developments. The existing studies on convergence of the focus exclusively on developed economies (Narayan, 2007; Wang, 2009; Apergis, 2013). This thesis provides empirical evidence for SSA in the post Abuja declaration period.

Finally, this thesis applies an extensive 41 countries panel for SSA and linear dynamic panel data model to investigate the relationship between health expenditure and health outcomes. Previous studies mainly used time series and cross-sectional (both in-country and cross-country) data. With exception of Novignon, et al. (2012) and Anyanwu and Erhijakpor (2007) who estimated static panel models, panel data have not been used. However, even the two studies do not consider dynamic effects. As argued by Arellano and Bond (1991), Arellano and Bouver (1995), Blundell and Bond (1998) incorporating dynamics in panel data models provide a deeper understanding of the relationship under study. Despite this, few studies of health economics have applied this method.

1.4 Organization of the Thesis

The remainder of the thesis is organized in five chapters. Chapter two, measures the convergence of health expenditure in SSA. Chapter three, examines the effects of health expenditure on child health in SSA and its sub-regions. Chapter four, investigates the effects of health expenditure on adult health in SSA and its sub-regions. Chapter five, presents a summary, conclusion, policy implications, and implications for future research.

CHAPTER TWO

HEALTH EXPENDITURE CONVERGENCE IN SUB-SAHARAN AFRICA AFTER ABUJA DECLARATION

1. Background and Problem Statement

The Abuja declaration on increasing public health expenditure (OAU, 2001) was a landmark attempt to address insufficient funds allocation to the health sector in Sub-Saharan Africa (SSA). The impetus for the Abuja Declaration came from the challenge of persistent burden of morbidity and mortality in Africa (UN Inter- Agency, et al., 2012; UN DESA, 2011; World Bank, 2013). The central focus was to reduce mortality and morbidity arising from HIV/AIDS, Malaria and Tuberculosis (OAU, 2001). Further, the Abuja target was made in the context of meeting Millenium Development Goals (MDGs) on health (UN, 2000). In the Abuja declaration, Africa Union states committed to allocate 15% of government expenditure to the health sector. There also exists other global efforts to help SSA governments sustain and increase health expenditure, such as Global Fund (Global Fund; 2011, 2012) and President Emergency Plan for AIDS Relief (PEPFAR, 2013).

Health expenditure in SSA before the Abuja Declaration was relatively low. For example, in the seven years (1995-2001) preceeding the Abuja Declaration the real per capita health expenditure, the average public health expenditure as a percent of total government expenditure and the average total health expenditure as a percent of GDP were US$ 76.74 (2005 PPP international), 7.9% and 5.2% respectively (World Bank, 2013). The corresponding world values were US$ 522, 15.1% and 9.1% respectively.

Since the Abuja declaration health expenditure in SSA has increased and health outcomes improved (morbidity and mortality rates have declined). The average real per capita health expenditure rose by more than US$ 45.10 while the average total health expenditure as a percent

of GDP and public health expenditure as a percent of government expenditure increased by about 1.3% and 1.6% respectively between 2001 and 2011 (World Bank, 2013).

Table 1, shows an upward trend in health expenditure in SSA for the period 2001- 2011 except for private health expenditure measures. Over the same period total health expenditure as a percent of GDP grew by 8.4% and the Abuja policy instrument, public health expenditure as a percent of government expenditure increased by 12.8%. Public health expenditure as a percent of GDP increased by about 0.3% and the public health expenditure as a percent of total health expenditure rose by 11.5%. The increase in public health expenditure measures, was accompanied by a decrease in private health expenditure measures during the post-Abuja period. However, within the private health expenditure component the share of out of pocket expenditure increased by about 2.7%.

Table 1 also shows that average per capita health expenditure in SSA rose by a massive 82% over the period 2001-2011. Despite the large increase in per capita health expenditure in SSA it was one seventh of the World's average per capita health expenditure. The average, however, hides large cross-country differences.

However, public health spending in most SSA countries falls short of the Abuja target (Tandon and Cashin, 2010). Consequently, the distribution and composition of health expenditure across SSA countries and overtime is uneven. Apart from Botswana which achieved the target for the period 2004-2007 other high per capita health expenditure (> US$350) SSA countries have not attained the target (World Bank, 2013).

The literature on determinants of health expenditure in SSA and other regions is extensive (Murthy and Okunade, 2009; Temah, 2009; Ke, et al., 2011; Lu, et al., 2010). However, the issue of health expenditure convergence among SSA countries has not been addressed. Several studies have examined convergence of health expenditure in developed countries and other regions

Table 1: Composition and Patterns of Health Expenditure in Sub-Saharan Africa 2001-2011

	2011		Growth in % (2001-2011)	High Health Expenditure Countries in 2011	Low Health Expenditure Countries in 2011
	SSA	World			
Total Health Expenditure as % of Gross Domestic Product	6.5	10.1	8.4	Liberia (19.5%), Sierra Leone (18.8%), Lesotho (12.7%)	Seychelles (3.8%), Central Africa, Rep. (3.8%), Eritrea (2.6%), Rep. of Congo (2.5%)
Public Health Expenditure as % of Gross Domestic Product	3.6	5.5	0.3	Lesotho (9.5%), Liberia (6.2%), Rwanda (6.1%), Swaziland (5.6%)	Guinea (1.6%), Eritrea (1.3%), Chad (1.2%)
Public Health Expenditure as % of Total Health Expenditure	45.1	59.7	11.5	Seychelles (92.1%), Cape Verde (75%), Equatorial Guinea (68%), Rep. of Congo (67%), Malawi (66%)	Sudan (28.4%), Guinea (27.3%), Chad (27.1%), Guinea-Bissau (26.8%), Sierra Leone (18%)
Public Health Expenditure as % of Government Expenditure	9.7	15.1	12.8	Rwanda (23.7%), Liberia (18.8%), Malawi (18.5%), Zambia (16%), Togo (15.4%), Madagascar (15.3%)	Eritrea (3.6%), Chad (3.3%), Uganda (2.5%), Sudan (2.4%), Nigeria (2%)
Private Health Expenditure as % of Total Health Expenditure	54.9	40.3	-8.2	Sierra Leone (82%), Cote d'Ivoire (73.7%), Uganda (73.7%), Guinea-Bissau (73.2%), Guinea (72.6%), Sudan (71.6%)	Seychelles (7.9%), Cape Verde (24.9%), Lesotho (25.9%), Malawi (26.6%)
Out-of-Pocket Health Expenditure as% Private Health Expenditure	56.5	49.7	2.7	27 countries spent >70% of total health expenditure.	Only 4 spent <20%. Botswana, Mozambique, Namibia, South Africa.
Private Health Expenditure as % of Gross Domestic Product	3.6	4.1	-2.3	Sierra Leone (15.4%), Uganda (7%), Sudan (6%), Burundi (5.9%), DR. Congo (5.7%), Sao Tome and Principe (5.2%)	Equatorial Guinea (1.3%), Eritrea (1.3%), Cape Verde (1.2%), Congo (0.8%), Seychelles (0.8%)
Health Expenditure per Capita (US$ in PPP International)	155	1024.33	82.1	Equatorial Guinea (1642), Seychelles (989.40), South Africa (942.50), Mauritius (841.90), Botswana (734.10),Swaziland (433.50), Namibia (364.80)	Madagascar (39.60), Niger (39.30), DR. Congo (32.10), Central Africa (30.90), Eritrea (16.99)

Source of data: World Bank (2013); World Health Organization (2013).

outside SSA (for example, Narayan, 2007; Wang, 2009; and Kerem, et al., 2008). However, SSA is unique in some respect. First, health sector in SSA countries rely heavily on donor funds. In 2011 donors funded more than 25% of total health expenditure in 25 SSA countries (World Health Organization, 2013). Second, several SSA countries received external debt relief under the HIPC Initiative (International Monetary Fund, 2013). Although some studies related health expenditure, donor funding and debt relief (Murthy and Okunade, 2009; Temah, 2009) none examined whether the two variables influenced convergence of health expenditure in SSA. Most countries which have achieved the Abuja target are over reliant on donor funding and/or benefitted from the debt relief initiatives (World Bank, 2013).

The main research question tackled in the study is whether health expenditure measures are converging across SSA countries in the post Abuja declaration period. Specifically, the following questions are addressed. First, have health expenditure measures in SSA converged after the Abuja declaration? Second, has the Abuja policy instrument (public health expenditure as a percent of government expenditure) affected the convergence of other health expenditure measures in the post Abuja declaration period? Third, has donor funding for health care, real per capita income and being HIPC debt relief country influenced the convergence of the health expenditure measures in the post-Abuja time period?

1.1 Research Objectives

The main objective of the study is to determine whether there is convergence of health expenditure after Abuja Declaration in SSA. The specific objectives are as follows:

a) To test for convergence in health expenditure in SSA after the Abuja Declaration.
b) To examine whether the Abuja declaration policy instrument (public health expenditure as a percent of government expenditure) has influenced convergence rates of other health expenditure measures in SSA.

c) To estimate whether donor funding, HIPC debt relief and real per capita GDP have influenced convergence of health expenditure in SSA.

1.2 Contribution of the Study

This study contributes to empirical literature on health expenditure in SSA in three ways. First, to the best of the author's knowledge this is the first econometric study on health expenditure convergence in SSA. Second, this study considers more health expenditure measures than the studies in developed regions which have only tackled convergence of per capita health expenditure and total health expenditure as a percent of GDP.

Convergence analysis of health expenditure in SSA is necessary to determine the extent of implementation of Abuja Declaration across its member countries. Furthermore, other initiatives aimed at the entire SSA region such as, Ouagadougou Declaration on primary health care and health system in Africa 2008 (Barry, et al., 2010) provide motivation to conduct health expenditure convergence analysis for SSA. The study of convergence of health expenditure allow one to understand how health systems are integrated and homogeneity in quality of health service delivery in SSA. The technocrats in the SSA health sector are also likely to use the study results to project timelines in which all member countries can achieve the Abuja target.

This study is relevant in the quest for determining whether, member countries of SSA are converging towards the target, of allocating 15% of government expenditure to public health service delivery. Subsequently, it is necessary to understand how the increase in public health expenditure as a percent of government expenditure as influenced the upward growth of other health expenditure measures in SSA. When public health expenditure as share of government expenditure was triggered up in 2001 there was a likelihood of increase in other measures of health expenditure. This implies that they are likely to trend together towards a higher equilibrium.

Second, the study tests for beta-convergence of health expenditure using dynamic panel data methods. Most of the health expenditure convergence literature have analyzed cross-sectional, time series data and panel data using unit root tests which yield stochastic convergence. Some which have attempted to measure beta convergence have used estimation methods which have not accounted for dynamics and endogeneity. Dynamic panel data estimation is able to account for endogeneity, unobserved heterogeneity and stationarity.

Third, the study goes beyond estimates of both absolute convergence and estimates conditional convergence on health expenditure while controlling for donor funding and HIPC debt relief. Although, Abuja Declaration has been in force since 2001 there has been uncertainty on the reasons why some countries are not fully implementing it. This study has examined whether or not external funding of health care, real income per capita and being Heavily Indebted Poor Countries debt relief beneficiary have contributed to convergence of health expenditure in Sub-Saharan Africa. Knowledge of how they have impacted on speed of achieving Abuja target in SSA is of high importance to deduce sources of variations in implementing the policy.

1.3 Organization of this Chapter

The remainder of this chapter is organized in four sections. Section 2, reviews the literature. Section 3, discusses the methodology used in the paper. Section 4 presents the empirical results on convergence of health expenditure measures. Section 5, presents a summary, conclusion and policy implications.

2. Literature Review

2.1 Convergence of Health Expenditure

Convergence is a process in which entities become similar overtime (O'Connor, 2013). Convergence analysis of health expenditure borrows its theoretical model from economic growth literature (Narayan, 2007; Hitiris and Nixon, 2001; Hofmarcher, et al., 2004). The convergence

hypothesis is in tandem with that of neoclassical economic growth models (Solow, 1956). The convergence hypothesis in health economics postulates that low healthcare spending economies tend to catch up with high health care spending ones to a common value (Hitiris, 1997; Narayan, 2007).

Three conceptualizations of convergence are exemplified in the literature. The beta β- convergence originates from economic growth literature (Barro, 1984; Boyle and McCarthy, 1997). It occurs when health spending in low health expenditure countries increases faster than in countries with high health expenditure over a given time horizon (Narayan, 2007). The alternative concept of sigma σ-convergence in health expenditure is also borrowed from the economic growth literature (Baumol, 1986; Barro and Sala-i-Martin, 1992). The σ-convergence in health expenditures is experienced if cross-country variation in expenditures decline overtime (Hitiris and Nixon, 2001). Stochastic convergence is also borrowed from economic growth literature (Benard and Durlauf, 1995; Carrion-i-Silvestre and German-Soto, 2008). Stochastic convergence occurs when health expenditure of one country relative to a reference country's health expenditure is stationary leading to a steady state (Carrion-i-Silvestre, 2005; Jewell, 2003).

Another concept that has gained prominence in the convergence literature is the club convergence (Dorwick and Delong, 2003). In the context of health expenditure a convergence club refers to a group of countries whose health expenditure tends to converge to a multiple steady state e.g. the health expenditure convergence is conditional on income, productivity or living standards differences. Ben-David (1994) identified two forms of club convergence: upward convergence club consisting of countries where the members catch up with the richer ones. High health expenditure countries are said to be in the upward convergence club. Downward convergence club, comprises extremely poor countries. This form of convergence reduces disparities between high and low health care spending countries.

In addition, to distinguishing β-convergence, the literature distinguishes absolute (unconditional) and conditional convergence (Wang, 2009). Absolute β-convergence, occurs when health care spending in a cross-section of countries converges to the same equilibrium, while conditional β-convergence, occurs when health expenditure converges to a different equilibrium.

2.2 Empirical Studies on Convergence of Health Expenditure

The empirical literature on convergence of health expenditure has concentrated on developed regions such as USA, European Union and OECD (e.g. Narayan, 2007; Wang, 2009; Panopoulou and Pantelidis, 2012; Hitiris and Nixon, 2001; Fallahi, 2011). A variety of estimation methods and data have been used to test convergence. The methods include, time series, cross-sectional and panel data econometric methods.

One strand of the literature used time series econometrics to test for convergence in health expenditure (for example, Narayan, 2007). For instance, the univariate and panel unit root tests such as Augmented Dickey–Fuller (ADF) and Lagrange Multiplier (LM) with structural breaks have been used in this type of literature. Narayan (2007) examined whether health expenditure of Spain, Canada, Japan, Switzerland and UK converged to US health expenditure over the period 1960-2000. Augmented Dickey-Fuller (ADF) test and Lagrange multiplier (LM) univariate and panel tests with structural breaks were used. The latter complements the ADF test which could yield misleading results as it is insensitive to structural breaks (Perron, 1989). The ADF estimates showed that there was no convergence in real per capita health expenditure between USA and three countries (Spain, Canada and Japan) but weak convergence with that of UK. On the other hand, the LM test results of the study indicated that when structural breaks are taken into account there was evidence of stochastic convergence in per capita health expenditure of the five countries to USA per capita health expenditure. The panel LM test with structural breaks provided strong statistical evidence that real per capita health expenditure converged in UK, Japan, Canada,

Switzerland and Spain. This implies that methods with structural breaks are more relevant in determining stochastic convergence in health expenditure. The study concluded that per capita health expenditure in UK, Canada, Japan, Switzerland and Spain converged to USA's per capita health expenditure.

Another strand of literature on health expenditure convergence are those which have used pooled cross-section data (for example, Hitiris and Nixon, 2001; Kerem, 2008; Wang, 2009). Hitiris and Nixon (2001) studied the convergence of health expenditure (per capita health expenditure and total health expenditure as share of GDP) in a panel of 15 European Union (EU) countries for the period 1960-1995. The estimate of σ- convergence was based on cross-sectional data spanning 1960-1995 (with 10 years averages), while the β- convergence estimate was based on panel data for 1980 to 1995. Non-parametric results for sigma σ- convergence support convergence of per capita health expenditure and total health expenditure as a share of GDP. This indicated that variability in the health expenditure variables were falling during the period 1960 to 1995 in EU. The paper applied a random effect model to determine existence of β- convergence. The absolute β- convergence estimates indicated that per capita health expenditure converged at the rate of 0.11% and total health expenditure as a ratio of GDP converged at the rate of 0.03%. The results also showed conditional convergence in per capita health expenditure at 0.09% and total health expenditure as a ratio of GDP 0.11%. The study concluded that the convergence estimates of health expenditure supports efforts for EU integration.

Kerem, et al. (2008) estimated the convergence of health expenditure in the European Union using a cross-sectional data with variables measured as averages over the period 1992 to 2004. The countries were divided in three groups: 23 (EU-23), 15 (EU-15) and 8 (EU-8). The authors tested for β- convergence of total health expenditure as share of real GDP and per capita health expenditure based on Kendall's index of rank concordance. The rate of convergence of total health

expenditure as share of GDP ranged between 0.04% and 0.05% among the three groups of EU member countries. The rate of convergence in per capita health expenditure was between 0.03% and 0.05%.

Convergence analysis can also be carried out among states or regions within a country. For example, Wang (2009) examined convergence of state level per capita health expenditure in the US for the period 1980 to 2004. The study used cross-section regressions with bootstrap confidence interval (CI), and multivariate stationarity test. The paper also tested for club convergence hypothesis. The estimated rate of absolute β-convergence was -1.7% and rate of convergence conditional on per capita income was -1.4% but statistically insignificant at conventional levels. Stationarity tests based on time series data revealed that 38 states formed 16 perfect convergence clubs consisting of two or three states. This means that stochastic convergence exists in the respective states. The health expenditure in 12 other states followed individual time paths. The authors concluded that a large number of convergence clubs is evidence of lack of convergence in health expenditure across US states.

A number of studies used panel time series to test existence of health expenditure convergence (Gerdtham and Löthgren, 2000; Fallahi, 2011; Aslan, 2009; Lau and Fung, 2013). Gerdtham and Löthgren (2000) investigated stationarity (stochastic convergence) of real per capita health expenditure for 21 OECD countries for the period 1960-1997 using ADF and Kwiatkowski-Phillips-Schimdt-Shin (KPSS) unit root tests. The ADF panel unit root estimates indicated that the unit root hypothesis cannot be rejected in the OECD. This may be as a result of low power unit-root data generation processes resulting from potential multicollinearity in the case of trending variables. An alternative test (KPSS) which corrects for multicollinearity with a null hypothesis of presence of stationarity was used in the study to verify the ADF estimates. The test rejected the

presence of stationarity of real per capita health expenditure. This result implied that real per capita health expenditure in the 21 OECD countries did not converge.

Fallahi (2011) tested for convergence of total health expenditure as a share of GDP in a panel of 10 OECD countries for the period 1960-2006. The test was based on LM and KPSS tests for stationarity and structural breaks. The beta convergence was tested using robust OLS. The panel unit root test result did not reject stationarity of total health expenditure as a share of GDP. This provided evidence for presence of stochastic convergence in total health expenditure as a share of GDP. There was no evidence of β-convergence for Austria, Finland, Iceland, Japan and UK. But Canada, Norway and Spain converged to the US total health expenditure. The author concluded that real convergence (stochastic and β at the same time) existed in Canada, Ireland, Norway and Spain before the structural breaks.

Aslan (2009) investigated convergence of per capita health expenditure among 19 OECD countries for the period 1970 to 2005. The author applied both panel unit root and persistent method to determine the presence of convergence between USA and OECD or within OECD countries. Using panel unit root test on real per capita health expenditure the unit root hypothesis was not rejected between OECD and USA and also within the OECD members. This indicated there was no stochastic convergence of per capita health expenditure in OECD and its relation with USA. Application of the persistent method[6] revealed stochastic convergence of per capita health expenditure relative to average OECD per capita health expenditure.

Unlike the previous studies Lau and Fung (2013) examined the existence of convergence of per capita health expenditure in 14 EU countries for the period 1975-2008 based on nonlinear panel

[6] Persistent method analyses unit root hypothesis by taking the ratio of per capita health expenditure for country I for period t to the average of the region for period t. This is then subjected to panel unit root estimation (Lima and Resende, 2007).

unit root test. This test assumed that growth of health expenditure was nonlinear because of structural changes arising from regional integration processes in EU. The authors argued that nonlinearity had not been taken into account in most of the conventional unit root tests. The test used was a non-linear panel Augmented-Dickey Fuller test which accounts for cross-sectional dependency[7]. The estimates indicated that unit root hypothesis could not be rejected even after accounting for nonlinearity which is not different from linear panel unit root test.

Literature on health expenditure convergence is moving toward the use of panel data estimation methods. Panopoulou and Pantelidis (2012) investigated whether or not per capita health expenditure in a panel of 19 OECD countries converged over the period 1972 to 2006 and whether or not health expenditure convergence led to convergence in health outcomes. The paper used a methodology developed by Phillips and Sul (2007) to test for sigma convergence and club convergence. The estimated results show per capita health expenditure for 19 OECD countries diverged at the rate of 0.5%. However, the study identified two convergence clubs. One club comprises of Norway and USA with higher per capita health expenditure. The second convergence club comprises the other 17 OECD countries. They concluded that convergence lead to a rise in health expenditure which results in funding deficit for the health sector. However, there was no evidence that convergence in health expenditure was accompanied by convergence in health outcomes.

Using a panel of 17 EU countries for the period 1990 to 2012 Apergis, et al. (2013) examined the convergence of various types of public expenditures as percentages of GDP. The study applied a panel convergence test developed by Phillips and Sul (2007) which permits testing for club convergence hypothesis. The study found that for the 17 countries public health expenditures did

[7] Cross sectional dependency refers to correlation across individual countries observations.

not exhibit club convergence. The study concluded that EU countries tend not to follow similar paths for their public health expenditure measures.

2.3 Summary and Conclusion

The studies reviewed in this chapter lead to several conclusions regarding the existence of convergence of health expenditure around the world. First, hardly any studies have examined health expenditure convergence in developing regions and none for SSA. This study advances literature on convergence of health expenditure by focusing on SSA and by examining a range of health expenditure measures unlike the existing studies. In addition to real per capita health expenditure and total health expenditure as a share of GDP, public health expenditure as share of government expenditure and, total health expenditure and private health expenditure as a share of total health expenditure are examined. The conditional variables such as being a HIPC debt relief beneficiary and benefitting from externally (donor) funded health care are unique to SSA health system and have been added in the analysis to understand how they have affected the achievement of Abuja Declaration target. The relative effects of Abuja policy instrument (public health expenditure as a percent of government) on growth of other health expenditure in post Abuja period is also estimated. It applied a new approach linear dynamic panel model and GMM-IV estimation method to SSA data to test for the convergence. This method controls for endogeneity, unobserved heterogeneity and stationarity and therefore yields estimates that are more robust than those from standard panel data methods or time series methods. Further, the method uses dynamic instruments which takes care of cross-sectional dependency.

3. Methodology

3.1 Theoretical Model

The theoretical model is modified under the premise of neoclassical theory of economic convergence (Swan, 1956; Barro, 1984; Abreu, et al., 2005). Assuming that health expenditure (HE) is a function of real GDP per capita (Y) and Population (P).

$$\boldsymbol{HE = f\,(Y, P)} \quad \text{.....(2.1)}$$

Real GDP per capita *(Y)* is assumed to increase health expenditure. This is because as an economy grows more welfare services such as provision of health care may attract more resource for improving human capital (e.g. health). Population is also a source of growth of health expenditure in a given country. Population influences the expansion of health expenditure, when additional resources are needed for health services given its health endowment.

Equation (2.1) is a general functional form. Assuming a Cobb-Douglas production function of health expenditure takes the form.

$$\boldsymbol{HE = A(Y)^{\alpha}\,(P)^{\beta}} \quad \text{..... (2.2)}$$

The inclusion of income in the growth equation of health expenditure is motivated from Wang (2009). He noted that health expenditure is a vital part of consumption and it is likely to converge across regions if income converges. Assuming that health expenditure ($\widetilde{he}$) and incomes ($\tilde{y}$) are expressed as ratio of population of a given country. A Taylor expansion of $\ln \tilde{y}$ around the steady state $\tilde{y}^{*}$ is specified as follows,

$$\frac{\dot{\tilde{y}}}{\tilde{y}} = \boldsymbol{\varphi}(\ln \tilde{y}^{*} - \ln \tilde{y}) \quad \text{..... (2.3)}$$

This implies that the growth rate of income per person ($\dot{\tilde{y}}$) is proportional to the distance between its current value and the steady state. φ is the rate of convergence of the steady state and can be

expressed as follows. $\varphi \approx (1-\alpha)(\pi + g + \delta)$. It depends on other factors such as growth of population (π), depreciation (δ) and the growth rate of knowledge (g) in a given country and other pertinent policies affecting the magnitude of health expenditure measure.

Assuming that the differential equation (2.3) and using the intensive Cobb-Douglas function $\widetilde{he} = \tilde{y}^{\alpha}$ equation 2.4 is derived.

$$\ln \widetilde{he}\ (t) = (1 - e^{-\varphi t}) \ln \widetilde{he}^{*} + e^{-\varphi t} \ln\ \widetilde{he}(0) \text{.....} \quad (2.4)$$

$\widetilde{he}(0)$ is per capita health expenditure at time zero. Equation (2.4) is converted to a model that can be tested empirically. The health expenditure is measured in per capita terms, $he = \widetilde{he}A$. Substituting for this equation in (2.4) it follows that,

$$\ln he\ (t) - \ln he(0) = (1 - e^{-\varphi t}) \ln A(0) + gt - (1 - e^{-\varphi t}) \ln he(0) + (1 - e^{-\varphi t}) \ln \widetilde{he}^{*} \text{ ..... } (2.5)$$

The initial level of health expenditure growth is assumed to be constant and k is a vector of control variables such as donor funding for health, HIPC debt relief and Abuja policy instrument (public health as a percent of government expenditure) determines the steady state. The convergence of health expenditure model in equation (2.5) can be expressed as follows:

$$\ln he\ (t) = \tau + \beta \ln[he(t) - \ln he\ (0)] + k'\gamma \text{ ..... } (2.6)$$

$\beta < 0$ takes the negative sign to imply convergence. γ is the vector coefficient of control variables. When the vector of control variables is assumed to be zero absolute convergence is determined. The β-convergence hypothesis states that countries with low health expenditure catch-up with those with high health expenditure over a given time period.

HIPC debt relief is likely to influence the growth of health expenditure. One of the condition of the award for the beneficiaries was to improve health indicators by allocating the extra resources in

public health services delivery. The Abuja policy instrument is likely explain the growth of other health expenditure measures in the health systems of SSA. The argument for inclusion of donor funding, HIPC debt relief and the Abuja policy instrument emanates from Wang (2009). He highlights the fact that coordination of policies across regions may influence resource redistributions which in tandem result in convergence of health expenditure where income convergence does not exist.

3.2 Testing for Convergence

This study specifies both absolute and conditional convergence of health expenditure in SSA based on the equation (2.6). The health expenditure variables are public health expenditure as a percent of government expenditure (Abuja policy instrument), real health expenditure per capita, total health expenditure as a share of GDP, public health expenditure as a share of total health expenditure and private health expenditure as a share of total health expenditure.

3.2.1 Absolute Convergence

The econometric specification for absolute beta (β) convergence is shown in equation (2.7).

$$\Delta \boldsymbol{E}_{i,t} = \boldsymbol{\zeta} + \boldsymbol{\zeta}_1 \boldsymbol{E}_{i,t-1} + \boldsymbol{\varepsilon}_{i,t} \quad \textit{\textbf{i=1, 2,…, N, t=1, 2,…, (T-1)}} \quad \text{……………………………..(2.7)}$$

Where $E_{i,t-1}$is the natural logarithm of the health expenditure variable of country *i*, in year $(t-1)$. $\Delta E_{i,t}$ is the natural growth of current health expenditure from the year $(t-1)$ to *t*. $\varepsilon_{i,t}$ is the idiosyncratic error term which has both time-specific and unobservable individual effects. The lagged health expenditure coefficient represents the convergence term. The convergence hypothesis is that high health expenditure countries tend to have lower health expenditure growth than low health expenditure countries. The ζ_1 is the convergence coefficient of $E_{i,t-1}$ and is expected to be negative, $\zeta_1 < 0$.

3.2.2 Conditional Convergence

The econometric specification used to test for conditional beta (β) convergence is an extended version of equation (2.7).

$$\Delta E_{i,t} = \psi + \psi_1 E_{i,t-1} + X'_{i,t-1}\Gamma + v_{i,t} \quad i=1, 2,\ldots, N, t=1, 2,\ldots, (T-1) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.8)$$

Where $E_{i,t-1}$ and $\Delta E_{i,t}$ are defined as in equation (2.7). $X_{i,t-1}$ is the vector of conditional variables. Two sets of conditional variables were used. One specification of the conditional variables are natural log of real income per capita, external funded health expenditure as percentage of total health expenditure and HIPC Debt relief dummy variable (to indicate whether or not a particular country was under the HIPC debt relief). In the second specification, the interaction of the Abuja policy instrument (public health expenditure as percent of government expenditure) with other health expenditure measures are added as conditional variables. This is to determine how change in public health expenditure as percent of government expenditure affects convergence (or divergence) of the other health expenditure measures. $v_{i,t}$ is the idiosyncratic error term comprising time-specific and unobservable individual effects.

If conditional β-convergence exists the coefficient of $E_{i,t-1}$ expected to be negative, $\psi_1 < 0$. Under conditional convergence each Sub-Saharan Africa country's health expenditure would converge to a different steady state.

3.3 Estimation Procedure

In this study absolute and conditional convergence in health expenditure are estimated using linear dynamic Generalized Method of Moments Instrumental Variables (LDPD GMM-IV). This hybrid estimation technique combines Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) estimators. Unlike static panel data methods such as fixed effects (FE) and random effects (RE), the LDPD not only controls for unobserved heterogeneity but also

endogeneity and unit root (accounts for stationarity). The estimates of fixed and random effects panel data models are presented for comparison with LDPD estimates. The instrument used in the estimation models are classified as either GMM type or standard with them being at levels or differenced. GMM instruments are based on moment functions that are dependent on observable random variables and unknown parameters that embody zero expectation in the population when evaluation is done at the true parameters (Wooldridge, 2002). Standard instruments are special case of GMM which assumes there is no heteroscedasticity.

The robustness for the dynamic panel estimates was checked by testing for instruments validity using Sargan over identification test. The Wald Criterion test was used to determine the overall significance of the estimated models. Finally, presence of serial correlation was tested using the Arellano-Bond autocorrelation test.

3.4 Definition of Variables and Data Sources

This section describes the data used in the convergence regressions. Table 2 presents the variables names (Column 1), a short description of the variable (column 2) and the source of data for each variable (column 3).

Table 2: Data Sources and Definition of Variables

Variable	Variable description	Data Source
Total health expenditure as % of GDP	Total health expenditure is the sum of public and private health expenditure. It covers expenditure for the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation. This is expressed as a ratio of GDP.	World Development Indicators (World Bank, 2013)
Real health expenditure per capita	Real health expenditure per capita is the sum of public and private health expenditures as a ratio of total population. Data are in international US$ converted using 2005 purchasing power parity (PPP) rates.	World Development Indicators (World Bank, 2013)

Public health expenditure as % of total health expenditure	Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds. This is expressed as a ratio total health expenditure.	World Development Indicators (World Bank, 2013)
Public health expenditure as % of government expenditure.	Public health expenditure consists of recurrent and capital spending expressed as ratio of total government expenditure. It is the Abuja Declaration 2001 policy instrument for raising health expenditure in Sub-Saharan Africa.	World Development Indicators (World Bank, 2013)
Private health expenditure as % of total health expenditure.	Private health expenditure includes direct household (out-of-pocket) spending, private insurance, charitable donations, and direct service payments by private corporations. This is expressed as a ratio of total health expenditure.	World Development Indicators (World Bank, 2013)
External health expenditure as % of total health expenditure (donor funding for health care)	External resources for health are funds or services in kind that are provided by entities not part of the country in question. The resources may come from international organizations, other countries through bilateral arrangements, or foreign nongovernmental organizations. These resources are part of total health expenditure.	World Development Indicators (World Bank, 2013)
Real income per Capita	GDP per capita based on purchasing power parity (Purchasing Power Parity).Data are in constant 2005 international US$.	World Development Indicators (World Bank, 2013)
HIPC Debt relief Dummy variable	Dummy variable for HIPC beneficiary countries in Sub-Saharan Africa. 1, HIPC beneficiary; 0, otherwise.	Various World Bank Bulletins for HIPC beneficiary Countries.

4. Empirical Results

4.1 Descriptive Statistics

The descriptive statistics for the variables considered in this chapter and defined in Table 2 are shown in Table 3. From Table 3, the pooled mean of total health expenditure as a ratio of GDP in the sample of countries over the period 2001-2011 was 5.9%. The minimum of total health expenditure as percent of GDP was reported in Equatorial Guinea in 2005 (1.7%) while the maximum was in Sierra Leone (22.2%) in 2009. The mean of Abuja declaration policy instrument (public health expenditure as a percent of government expenditure) was 9.5%, below the target of

15% envisaged in the declaration. This indicates that some of Sub- Saharan Africa countries have not been implementing the policy. The country that reported the highest public health expenditure as a percent of government expenditure was Equatorial Guinea in 2002 (26.9%) while Sudan had the lowest 0.97% in 2001.

The mean of public health expenditure as a percent of total health expenditure was 48.4% during 2001-2011. This indicates that slightly over half (51.6%) of health care expenditure in SSA was from the non state sector. Congo, Democratic Republic had the lowest public health expenditure as percent of total health expenditure at (5.3%) in 2001 which culminated to having highest private health expenditure as a percent of total health expenditure of 94.7%. On the other hand, Seychelles reported the highest public health expenditure as percent of total health expenditure (93.5%) in 2006 hence having the lowest private health expenditure ratio of total health expenditure of 6.5%.

Table 3: Descriptive Statistics of Variables included in Health Expenditure Convergence Models

Variable	Mean	Std. Dev	Min	Max
Total Health Expenditure as a percent of GDP	5.9	2.6	1.7	22.2
Public Health Expenditure as a percent of Government Expenditure	9.5	4.5	0.97	26.9
Public Health Expenditure as a percent of Total Health Expenditure	48.4	17.2	5.3	93.5
Private Health Expenditure as a percent of Total Health Expenditure	51.6	17.2	6.5	94.7
Real Health Expenditure Per capita (PPP, 2005 International US$)	166.4	233.8	9.6	1806.5
Real GDP per Capita (PPP, 2005 International US$)	3295.8	5164.9	247.9	31968.6
External funded health expenditure as a percent of Total Health Expenditure	21.8	18.0	0.20	92.0
HIPC Debt Relief Dummy (1: Beneficiary; 0 otherwise)	0.30	0.48	0	1

Note: Number of Observations = 495.

The mean of real health expenditure per capita is US$166.4. Although, higher than health expenditure per capita (US$ 34- US$40) recommended by Commission on Macroeconomics and Health (Commission on Macroeconomic and Health, 2001) the standard deviation among SSA countries is large. During the period 2001-2011, the minimum real health expenditure per capita (US$ 9.6) was recorded in Congo, Democratic Republic in 2001 while Equatorial Guinea (US$ 1,806) had the maximum real per capita health expenditure in 2009.

Sub-Saharan Africa can be classified in the lower middle income category. This is because the average real GDP per capita (real income per capita) of US$ 3,295.80 falls within the per capita range of US$ 1035- US$4,086 as defined by World Bank (2014). However, the standard deviation showed large disparities in income distribution in the sub-continent. The lowest real GDP per capita US$247 was recorded in Congo, Democratic Republic in 2001 while the highest (US$ 31, 968.6) was recorded in Equatorial Guinea in 2011. The average of external (donor) funded health expenditure, 21.8% indicated that Sub-Saharan Africa countries depend substantially on donor funds to run health systems. The country with the lowest donor funded health care was South Africa (0.2%) while Eritrea health care was highly supported by donors at 92% of their total health expenditure in 2004. The statistics show that during the period 2001-2011 about 30% of SSA countries benefitted from HIPC debt relief. .

4.2 Absolute and Conditional Convergence of Health Expenditure in Sub-Saharan Africa

This section presents estimates for absolute and conditional convergence of health expenditure in Sub-Saharan Africa corresponding to equations (2.7) and (2.8). As indicated earlier in contrast studies of developed countries health expenditure, this study estimated convergence of multiple measures of health expenditure. The sub-sections 4.2.1 to 4.2.5 present econometric estimates for specific measures of health expenditure.

4.2.1 Public Health Expenditure as a Percent of Government Expenditure

Table 4 present estimates of absolute and conditional convergence of public health expenditure as a percent of government expenditure. This variable was the Abuja Declaration policy instrument picked in 2001 and the target was 15%. The results of two model specifications are presented. The rate of absolute convergence of public health expenditure as percent of government expenditure is estimated in model 1. Model 2 extends model 3 by adding three control variables: external health expenditure as a percent of total health expenditure, HIPC debt relief dummy and real income per capita. This yields conditional convergence rate. As explained previously the GMM- IV estimator is able to control for endogeneity and autocorrelation problems. The presentation of results is primarily focused on GMM models.

The p-value of the Wald test rejects the null hypothesis that the explanatory variables do not jointly explain growth of public health expenditure. The p-values of Sargan test for instruments validity suggest that the null hypothesis cannot be rejected and over identifying restrictions are valid. The Arellano Bond test of serial correlation does not reject the null hypothesis of no second order autocorrelation as indicated by the larger p-values. Therefore, the diagnostic tests suggest that the estimates are consistent.

In model 1 of Table 4, the coefficient estimate of the lagged public health expenditure as a percent of government expenditure is negative (-5.37) and significant (p-value = 0.03). This estimate of absolute convergence implies that public health expenditure as percent of government expenditure in SSA countries converges towards the Abuja target at the rate of 5.4% per year between 2001 and 2011. In contrast to this study Apergis, et al. (2013) did not find absolute convergence of health expenditure for 17 EU countries.

Turning to conditional convergence (model 2), the coefficient estimate of lagged public health expenditure as a percent of government expenditure is -5.70 with p-value of 0. This indicates that

Table 4: Absolute and Conditional Convergence of Public Health Expenditure (Dependent Variable is Growth of Public Health Expenditure as a Percent of Government Expenditure)

Independent Variables	Model 1: Absolute Convergence			Model 2: Conditional Convergence		
	FE	RE	LDPD	FE	RE	LDPD
Lagged public health expenditure as a percent of government expenditure	**-5.316*** (-9.50)	**-1.623*** (-5.29)	**-5.369** (-2.19)	**-5.295*** (-9.30)	**-1.773*** (-5.33)	**-5.698*** (-6.70)
Lagged external health expenditure as a percent of total health expenditure	-	-	-	**-0.02** (-0.13)	**0.110** (1.13)	**0.038** (0.15)
Lagged ln(real GDP per capita)	-	-	-	**-25.885**** (-2.05)	**-2.075** (-1.22)	**-54.476**** (-2.45)
Heavily Indebted Poor Countries (HIPC) debt relief dummy variable (1 if beneficiary. O otherwise)	-	-	-	**1.821** (0.37)	**-1.754** (-0.55)	**23.819*** (1.70)
Constant	**55.383*** (10.13)	**20.380*** (6.34)	**55.889*** (6.18)	**247.389*** (2.65)	**35.496*** (2.54)	**455.047*** (2.33)
Number of Observations	450	450	450	450	450	450
F-Test, (p-value)	90.17 (0.00)	-	-	23.71 (0.00)	-	-
R-Squared	18.2	18.3	-	19.1	17.4	-
Wald Test χ^2, (p-value)	-	28.03 (0.00)	4.81 (0.03)	-	33.86 (0.00)	183.09 (p=0.00)
Hausman test χ^2, (p-value)	62.16 (0.00)		-	64.28 (0.00)		-
Sargan Test χ^2, (p-value)	-	-	9.270 (0.99)	-	-	12.609 (1.00)
Arellano-Bond Autocorrelation test (AR2) z-value (p=value)			-0.331 (0.74)			-0.525 (0.60)
Number of Instrumental Variables			29			48

Notes: (1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model

(2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses;

(3) ***, **, * show significance of the estimates at 1%, 5% and 10%.

(4) Instruments: Model 1 (GMM-IV four period lagged public health expenditure as a percent of government expenditure); Model 2 (GMM-IV two period lagged public health expenditure as a percent of government expenditure).

the rate of conditional convergence of public health expenditure as a percent of government expenditure is 5.7% conditional on external health expenditure as a percent of total health expenditure, being a beneficiary of HIPC debt relief and real income per capita.

The percentage of health expenditure funded from external (donor) sources has positive but insignificant impact on growth of public health expenditure. HIPC debt relief beneficiary countries had higher growth in public health expenditure as a percent of government expenditure compared to non HIPC beneficiary countries. Growth in real per capita income in SSA had negative impact on growth of public health expenditure.

4.2.2 Real per Capita Health Expenditure

Table 5 present the estimates of absolute convergence (model 3) and conditional convergence (Model 4 and Model 5) of real per capita health expenditure in SSA. In model 4 the convergence of real per capita health expenditure was tested conditional on whether country received debt relief under HIPC, external health expenditure as a percent of total health expenditure and real income per capita. Model 5, is extension of model 6. It includes public health expenditure as percent of government expenditure (Abuja policy instrument) and the interaction of public health expenditure as percentage of government expenditure and real per capita health expenditure. Model 5 results are used to determine how Abuja policy instrument has affected the convergence rate of real per capita health expenditure between 2001 and 2011.

Based on the p-values of Wald test, the null hypothesis that there is no joint significance of the explanatory variables is rejected. The Arellano-Bond autocorrelation test does not reject the null hypothesis of no autocorrelation since the test statistics are statistically insignificant as indicated by respective p-values. This suggests that there is no serial correlation in the first difference errors of these models. The p-value of the Sargan test statistic indicate that the test fails to reject the null

Table 5: Absolute and Conditional Convergence of Real Health Expenditure (Dependent Variable is Growth of Real per Capita Health Expenditure)

Panel A. Regression Results									
Independent Variables	**Model 3: Absolute Convergence**			**Model 4: Conditional Convergence I**			**Model 5: Conditional Convergence II**		
	FE	**RE**	**LDPD**	**FE**	**RE**	**LDPD**	**FE**	**RE**	**LDPD**
Lagged ln (real health expenditure per capita)	**-4.147***** (-7.57)	**-0.541***** (-3.23)	**-3.259***** (-3.04)	**-7.262***** (-9.17)	**-1.759***** (-4.32)	**-8.736***** (-5.26)	**-8.261***** (-9.81)	**-3.198***** (-7.64)	**-7.220***** (-3.88)
Public health expenditure as a percent of government expenditure* lagged ln (real health expenditure per capita)	-	-	-	-	-	-	**0.155***** (11.49)	**0.148***** (11.73)	**0.178***** (3.37)
Lagged public health expenditure as a percent of government expenditure	-	-	-	-	-	-	**-0.453***** (-6.48)	**-0.604***** (-10.23)	**-0.693***** (-4.37)
Lagged external health expenditure as percent of total health expenditure	-	-	-	**0.049***** (2.69)	**0.002** (0.18)	**0.117***** (2.82)	**0.039**** (2.51)	**0.001** (0.06)	**0.078**** (2.44)
Lagged ln (real GDP per capita)	-	-	-	**8.409***** (4.42)	**1.344***** (3.11)	**12.053***** (4.71)	**9.116***** (4.99)	**1.490***** (3.50)	**8.067***** (2.84)
Heavily Indebted Poor Countries (HIPC) debt relief dummy variable	-	-	-	**1.095**** (1.97)	**0.164** (0.44)	**2.350**** (2.27)	**0.899*** (1.87)	**0.349** (0.99)	**1.769***** (2.87)
Constant	**20.223***** (8.19)	**3.995***** (5.18)	**16.227***** (3.36)	**-29.713***** (-2.48)	**-0.614** (-0.31)	**-52.095*** (-1.81)	**-32.580***** (-2.90)	**4.063**** (2.01)	**-29.353***** (-1.99)
Number of Observations	450	450	450	450	450	450	450	450	450
F-Test, (p-value)	57.36 (0.00)	-	-	23.18 (0.00)	-	-	43.76 (0.00)	-	-
R-Squared	0.12	0.12	-	0.19	0.17	-	0.40	0.34	-
Wald Test χ^2, (p-value)	-	10.46 (0.00)	17.81 (0.00)	-	21.35 (0.00)	28.56 (0.00)		177.19 (0.00)	20.92 (0.00)
Hausman test χ^2, (p-value)	47.83 (0.00)		-	77.03 (0.00)		-	58.20 (0.00)		-

Sargan Test χ^2, (p-value)	-	-	17.006 (p=0.93)	-	-	53.75 (0.13)		-	43.55 (p=0.36)
Arellano-Bond Autocorrelation test (AR2) z-value (p=value)			AR(4): -1.398 (0.16)			AR(2) -1.333 (0.18)			AR(2) -0.279 (0.78)
Number of Instrumental Variables			29	-	-	48			48
Panel B: Evaluation of the impact of Abuja policy instrument on convergence of real per capita health expenditure for conditional model with interactive term (model 5) (evaluated at the mean of SSA = 9.5%, Abuja Threshold =15%)									
						Mean			**15% Threshold**
The coefficient estimate of lagged real per capita health expenditure.						**-7.220**			**-7.220**
The coefficient of interaction of ln (real per capita health expenditure) and public health expenditure as a percent of government expenditure (0.178)						1.691			2.67
Net Convergence rate						**-5.529**			**-4.55**

Notes: (1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model
(2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses;
(3) Mean value (9.5%) obtained from descriptive statistics in Table 3.
(4) Instruments: Model 3 (four period lagged ln (real per capita health expenditure) (GMM); Model 4 (two period lagged ln (real per capita health expenditure) (GMM), one period lagged difference of external health expenditure as a percent of total health expenditure, HIPC debt relief dummy); Model 5 (two period lagged ln (real per capita health expenditure) (GMM) , one period lagged difference of external health expenditure as a percent of total health expenditure (GMM), one period lagged external health expenditure as a percent of total health expenditure and HIPC debt relief dummy).

hypothesis that the instruments used in the models are valid. Thus the results of diagnostic tests suggest the models are correctly specified.

Model 3 tests for absolute convergence of real per capita health expenditure. The coefficient of the lagged real per capita health expenditure is -3.26 and significant at 1% level. This result suggest that SSA countries converged to the same equilibrium of real per capita health expenditure at the rate of 3.3% per year between 2001 and 2011. Other studies in developed regions support the findings. Wang (2009) found an absolute convergence of -1.7% in US. Hitiris and Nixon (2001) found absolute convergence of -0.03% for EU. Kerem, et al. (2008) also found absolute convergence ranging from -0.03% to -0.05% for per capita health expenditure in EU. Other studies have found stochastic convergence for per capita health expenditure (Aslan, 2009; Wang, 2009) but Gerdtham and Löthgren (2000) and Lau and Fung (2013) did not find stochastic convergence.

Next, focusing on model 4 to test for conditional convergence, the coefficient of the lagged real per capita health expenditure is -8.74 and significant at 1%. The estimate indicate that the convergence rate of real per capita health expenditure in SSA was 8.7% conditional on share of total health expenditure financed by external donor funding, real per capita income and HIPC debt relief. Thus increase in external funding for health care, real per capita income and having benefitted from the HIPC debt relief increased the growth of real per capita health expenditure. All the conditional factors had positive and significant coefficients. Hitiris and Nixon (2001) found conditional convergence for per capita health expenditure at -0.09% in EU and in US Wang (2009) found a conditional convergence of -1.4%.

In order to test whether or not convergence rate in real per capita, health expenditure was influenced by the Abuja policy variable (public health expenditure as a share of total government expenditure) an interactive variable between one period lag of natural log real per capita health expenditure and public health expenditure as a percentage of government expenditure was included (Table

5, Model 5). The coefficient of lagged real per capita health expenditure and of the interactive variable are negative and positive respectively. Both are statistically significant. If SSA governments allocate 9.5% (mean) of their government budgets to public health the conditional convergence rate for real per capita health expenditure is about 5.5% (Table 5, Panel B). On the other hand, if they allocate 15% of their total government expenditure to public health the rate of conditional convergence is 4.55%. The coefficients of conditional variables in model 5 are positive and significant. But the magnitudes are smaller than in model 4.

4.2.3 Total Health Expenditure as a Percent of GDP

Table 6 present the results for both absolute and conditional convergence of total health expenditure as percent of GDP for Sub-Saharan Africa. Estimates of absolute convergence are presented under model 6. Model 7 and model 8 provide estimates of total health expenditure as a percent of GDP conditional convergence.

As indicated by the p-values of the Wald test in model 6, model 7 and model 8, the null hypothesis that all explanatory variables coefficients are jointly zero is rejected. The Arellano-Bond autocorrelation test did not reject the null hypothesis of no serial correlation as indicated by the large p-values. Finally, as indicated by the p-values of the Sargan test, the null hypothesis that the over identification restrictions are valid cannot be rejected. Therefore, the instruments used in the models are valid.

In model 6 of Table 6, the lagged total health expenditure as a percent of GDP coefficient estimate is -5.98 and significant at 1%. This indicates that total health expenditure as a percent of GDP in SSA converges towards the same equilibrium at the rate of 5.98% per year over the period 2001-2011. Literature from the developed region have also shown the same results. Kerem, et al. (2001) found absolute convergence of between -0.04% and -0.05% for total health expenditure as a percent of GDP and Hitiris and Nixon (2001) reported a convergence of -0.11%. Fallahi (2011) showed

Table 6: Absolute and Conditional Convergence of Total Health Expenditure (Dependent Variable is Growth of Total Health Expenditure as a Percent of GDP)

Panel A: Regression Results									
Independent Variables	**Model 6: Absolute Convergence**			**Model 7: Conditional Convergence I**			**Model 8: Conditional Convergence II**		
	FE	**RE**	**LDPD**	**FE**	**RE**	**LDPD**	**FE**	**RE**	**LDPD**
Lagged total health expenditure as a percent of GDP	**-5.558***** (-9.06)	**-0.827***** (-3.00)	**-5.979***** (-4.92)	**-6.045***** (-9.42)	**-0.863***** (-3.05)	**-9.428***** (-3.59)	**-11.418***** (-12.98)	**-4.969***** (-9.96)	**-17.065***** (-8.62)
Public health expenditure as a percent of government expenditure* lagged total health expenditure as a percent of GDP	-	-	-	-	-	-	**0.485***** (10.62)	**0.391***** (10.04)	**0.634***** (4.23)
Lagged public health expenditure as a percent of government expenditure	-	-	-	-	-	-	**-1.883***** (-5.85)	**-2.403***** (-9.13)	**-8.091***** (-8.06)
Lagged external health expenditure as a percent of total health expenditure	-	-	-	**0.121** (1.48)	**-0.008** (-0.16)	**0.822**** (2.27)	**0.095** (1.31)	**-0.040** (-0.88)	**0.709*** (1.83)
Lagged ln (real GDP per capita)	-	-	-	**11.853*** (1.86)	**-0.645** (-0.75)	**31.163**** (2.12)	**11.527**** (2.03)	**-0.615** (-0.79)	**9.932*** (1.69)
Heavily Indebted Poor Countries (HIPC) debt relief dummy variable	-	-	-	**0.403** (0.17)	**-0.239** (-0.15)	**16.615***** (2.72)	**0.736** (0.34)	**1.711** (0.243)	**17.004***** (2.91)
Constant	**35.352***** (9.70)	**7.697***** (4.39)	**37.813***** (5.31)	**-52.661** (-1.13)	**12.954*** (1.74)	**-197.478*** (-1.73)	**-29.217** (-0.70)	**36.361***** (5.10)	**46.542** (1.05)
Number of Observations	450	450	450	450	450	450	450	450	450
F-Test, (p-value)	82.03 (0.00)	-	-	22.39 (0.00)	-	-	38.55 (0.00)	-	-
R-Squared	0.17	0.17	-	0.18	0.15	-	0.37	0.27	-
Wald Test χ^2, (p-value)		9.00 (0.00)	16.77 (0.00)	-	9.57 (0.05)	13.88 (0.01)		115.90 (0.01)	257.92 (0.00)
Hausman test χ^2, (p-value)	74.47		-	81.60		-	158.24		-

	(0.00)			(0.00)			(0.00)		
Sargan Test χ^2, (p-value)	-	-	44.85 (0.12)	-	-	15.087 (0.30)	-	-	39.38 (0.21)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(2) -0.406 (0.68)			AR(6) -0.983 (0.33)			AR(2) 0.096 (0.92)
Number of Instrumental Variables			37	-	-	18			40

Panel B: Evaluation of the impact of Abuja policy instrument on convergence of total health expenditure as percent of GDP for conditional model (model 8) with interactive term (evaluated at the mean of SSA = 9.5%, Abuja threshold =15%)

	Mean	**Threshold (155)**
The coefficient estimate of lagged total health expenditure as a percent of GDP	**-17.065**	**-17.065**
The coefficient of interaction of total health expenditure as a percent of GDP and public health expenditure as a percent of government expenditure (0.634)	6.023	9.51
Net Convergence rate	**-11.042**	**-7.555**

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model

2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses;

3) Where p= are the probability values.

4) Instruments: Model 6 (three period lagged total health expenditure as a percent of GDP (GMM): Model 7 (six period lagged total health expenditure as a percent of GDP (GMM) , difference of HIPC, and one period lagged difference of external health expenditure as a percent of total health expenditure, HIPC debt relief dummy and one period lagged external health expenditure). Model 8 (two period lagged total health expenditure as a percent of GDP (GMM), difference of growth of total health expenditure as a percent of GDP, one period lagged difference of ln (real income per capita), HIPC debt relief dummy).

that total health expenditure exhibited beta convergence among some countries in OECD as well as stochastic convergence.

The estimates of model 7, show that the coefficient estimate of lagged total health expenditure as a percent of GDP is -9.43 and significant. This means that total health expenditure as a percent of GDP conditionally converge at 9.43%. Hitiris and Nixon (2001) found a conditional convergence of 0.11% in EU for total health expenditure as a percent of GDP. The conditional variables external health expenditure as a percent of total health expenditure, real income per capita and being HIPC debt relief beneficiary are positive and statistically significant.

Model 8 repeats the analysis but includes interaction term between total health expenditure as a percent of GDP and public health expenditure as a percent of government expenditure. Total health expenditure as a percent of GDP has a negative and significant coefficient. The coefficient of the interaction term is positive and significant. Panel B of Table 6, shows that at the mean (9.5%) of public health expenditure as a percent of government expenditure, the conditional convergence rate of total health expenditure as a percent of GDP is 11.04%. However, if the public health expenditure as a percent of government expenditure is at the Abuja target (15%), the conditional convergence rate of total health expenditure as a percent of GDP falls to 7.56%. The results indicate that as countries in SSA implement the Abuja declaration the convergence rate of total health expenditure as a percent of GDP slows across the member countries. As in model 7, the conditional variables have positive and significant coefficients. However, the coefficients are much larger than those in model 7.

4.2.4 Public Health Expenditure as a Percent of Total Health Expenditure

Table 7 present the estimates of absolute and conditional convergence of public health expenditure as a percent of total health expenditure. The models pass various diagnostic tests, suggesting that they are well specified. The Wald test rejects the null hypothesis that all coefficients

Table 7: Absolute and Conditional Convergence of Public Health Expenditure (Dependent Variable is Growth of Public Health Expenditure as a Percent of Total Health Expenditure)

Panel A: Regression Results									
Independent Variables	**Model 9: Absolute Convergence**			**Model 10: Conditional Convergence I**			**Model 11: Conditional Convergence II**		
	FE	**RE**	**LDPD**	**FE**	**RE**	**LDPD**	**FE**	**RE**	**LDPD**
Lagged public health expenditure as a percent of total health expenditure	**-1.401***** (-10.15)	**-0.270***** (-5.32)	**-1.633***** (-4.49)	**-1.375***** (-9.83)	**-0.248***** (-4.18)	**-2.302***** (-3.91)	**-1.866***** (-9.97)	**-0.666***** (-7.40)	**-2.203***** (-4.10)
Public health expenditure as a percent of government expenditure* lagged public health expenditure as a percent of total health expenditure	-	-	-	-	-	-	**0.047***** (7.02)	**0.047***** (7.69)	**0.067***** (3.05)
Lagged public health expenditure as a percent of government expenditure	-	-	-	-	-	-	**-0.917**** (-2.00)	**-2.164***** (-6.53)	**-0.241** (-0.17)
Lagged external health expenditure as a percent of total health expenditure	-	-	-	**-0.103** (-1.03)	**0.004** (0.06)	**-0.210** (-0.59)	**-0.140** (-1.48)	**-0.055** (-0.87)	**-0.255*** (-1.66)
Lagged ln (real GDP per capita)	-	-	-	**-3.445** (-0.45	**-0.558** (-0.44)	**195.930***** (2.91)	**-0.241** (-0.03)	**-0.443** (-0.35)	**41.520***** (2.58)
Heavily Indebted Poor Countries (HIPC) debt relief dummy variable	-	-	-	**-0.655** (-0.22)	**-2.685** (-1.36)	**-25.133*** (-1.90)	**-1.538** (-0.55)	**-2.105** (-1.08)	**-15.038*** (-1.85)
Constant	**70.157***** (10.47)	**15.625***** (6.03)	**81.324***** (4.63)	**96.963*** (1.70)	**19.677**** (2.15)	**-1329.168***** (3.15)	**83.241** (1.54)	**37.072***** (3.91)	**-219.868***** (-2.14)
Number of Observations	450	450	450	450	450	450	450	450	450
F-Test, (p-value)	103.00 (0.00)	-	-	26.07 (0.00)	-	-	27.65 (0.00)	-	-
R-Squared	0.20	0.20	-	0.21	0.17	-	0.29	0.21	-
Wald Test χ^2, (p-value)	-	28.34 (0.00)	20.12 (0.00)	-	29.93 (0.00)	18.51 (0.00)		96.26 (0.00)	134.01 (0.00)
Hausman test χ^2 , (p-value)	77.63		-	82.50			117.58		-

	(0.00)			(0.00)			(0.00)		
Sargan Test χ^2, (p-value)	-	-	27.879 (0.97)	-	-	18.889 (0.76)	-	-	21.738 (0.99)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(2) 1.235 (0.22)			AR(3) 1.221 (0.22)			AR(2) -0.501 (0.62)
Number of Instrumental Variables			46	-	-	29			48

Panel B: Evaluation of the impact of Abuja policy instrument on convergence of public health expenditure as percent of total health expenditure for conditional model with interactive term (model 11) (evaluated at the mean of SSA = 9.5%, Abuja threshold =15%)		
The coefficient estimate of lagged public health expenditure as a percent of total health expenditure	**Mean**	**Threshold**
	-2.203	**-2.203**
The interaction of public health expenditure as a percent of total health expenditure with public health expenditure as a percent of government expenditure (0.067)	0.637	1.005
Net Convergence rate	**-1.566**	**-1.198**

Notes:1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model.

2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses.

3) Where p= are the probability values.

4) Instruments: Model 9 (two period lags of public health expenditure as a percent of total health expenditure (GMM): Model 10 (three period lags of growth of public health expenditure as a percent of total health expenditure (GMM)): Model 11 (two period lags of public health expenditure as a percent of total health expenditure (GMM), one period lagged difference of external health expenditure as a (GMM), one period lagged difference of public health expenditure as a percent of total health expenditure (GMM) and one period lag of public health expenditure as percent of total health expenditure).

of explanatory variables are jointly equal to zero. Arellano-Bond autocorrelation test does not reject the null hypothesis of no serial correlation in the first difference errors. Sargan test does not reject the null hypothesis that over identification restrictions are valid.

The lagged public health expenditure as a percent of total health expenditure in model 9 is negative (-1.63) and significant at 1% level. The associated coefficient implies that absolute convergence of public health expenditure as a percent of total health expenditure was 1.63% annually during the period 2001-2011.

Estimates of model 10, indicate that the coefficient of public health expenditure as a percent of total health expenditure is -2.30 and significant at 1%. This implies that conditional on HIPC debt relief, real income per capita and donor funding for health to public health expenditure as a percent of total health expenditure converged at 2.3% per year to different steady states.

The coefficient estimate of external health expenditure as a percent of total health expenditure (donor funding for health) is negative but insignificant. Real income per capita has a positive and significant coefficient while HIPC debt relief has a negative and significant coefficient. This means that holding other variables constant increase in real income per capita increases growth in public health expenditure as a percent of total health expenditure. On the other hand, holding other variables constant HIPC debt relief beneficiary countries had lower public health expenditure as a percent of total health expenditure than non HIPC debt relief countries.

Turning to the model with interaction term (model 11), coefficient of lagged public health expenditure as a percent of total health expenditure is negative and significant at 1% level. The interaction term between public health expenditure as a percent of total health expenditure and Abuja policy instrument is positive and significant. When public health expenditure as a percent of government expenditure is at its mean (9.5%) the conditional convergence rate of public health

expenditure as a percent of total health expenditure is 1.57%. But when public health expenditure as a percent of government expenditure is at the Abuja target (15%) the conditional convergence public health expenditure as a percent of total health expenditure is 1.2%. Both external health expenditure as a percent of total health expenditure and HIPC debt relief are negative and significant. Real income per capita coefficient is positive and significant.

4.2.5 Private Health Expenditure as a Percent of Total Health Expenditure

The estimates of absolute and conditional convergence in private health expenditure as a percent of total health expenditure are displayed in Table 8. All the diagnostic tests are satisfactory, suggesting the models are well specified. The Wald test for overall significance of explanatory variables rejects the null hypothesis of no joint significance. The Arellano-Bond autocorrelation test does not reject the absence of serial correlation and the Sargan test does not reject the over identification restrictions.

The lagged private health expenditure as a percent of total health expenditure enters model 12 with a negative and significant coefficient of -1.24. This implies an absolute convergence rate of 1.24% in private health expenditure as a percent of total health spending. But conditional on real income per capita, HIPC debt relief and external health expenditure as a percent of total health expenditure (model 13) the convergence rate of private health expenditure as percent of total health expenditure was 0.75%. External health expenditure as a percent of total health expenditure (donor funding) coefficient is positive and insignificant while that one of HIPC debt relief enters with a positive and significant coefficient. Real income per capita enters with a negative and significant coefficient. An increase in real income per capita reduces the growth of private health expenditure as a percent of total health expenditure. The beneficiaries of HIPC debt relief had higher growth in private health expenditure as a percent of total health expenditure than non HIPC countries.

Table 8: Absolute and Conditional Convergence of Private Health Expenditure (Dependent Variable is the Growth of Private Health Expenditure as a Percent of Total Health Expenditure)

Panel A: Regression Analysis									
Independent Variables	**Model 12: Absolute Convergence**			**Model 13: Conditional Convergence I**			**Model 14: Conditional Convergence II**		
	FE	**RE**	**LDPD**	**FE**	**RE**	**LDPD**	**FE**	**RE**	**LDPD**
Lagged private health expenditure as a percent of total health expenditure	**-0.949***** (-10.33)	**-0.106***** (-3.21)	**-1.241*** (-1.79)	**-0.959***** (-10.31)	**-0.126***** (-3.20)	**-0.753**** (-2.20)	**-0.507***** (-4.79)	**0.343***** (6.82)	**-1.015**** (-2.43)
Public health expenditure as a percent of government expenditure* lagged private health expenditure as a percent of total health expenditure	-	-	-	-	-	-	**- 0.059***** (-13.68)	**-0.047***** (-12.84)	**-0.105***** (-6.68)
Lagged public health expenditure as a percent of government expenditure	-	-	-	-	-	-	**1.287***** (4.87)	**2.538***** (11.82)	**-0.074** (-0.05)
Lagged external health expenditure as a percent of total health expenditure	-	-	-	**-0.048** (-0.73)	**-0.033** (-0.77)	**0.135** (0.77)	**-0.010** (-0.19)	**-0.054** (-1.49)	**-0.013** (-0.14)
Lagged log of real GDP per capita	-	-	-	**5.413** (1.06)	**-0.786** (-0.94)	**-22.504**** (-2.13)	**1.605** (0.38)	**-0.540** (-0.75)	**-54.144***** (-3.69)
Heavily Indebted Poor Countries (HIPC) debt relief dummy variable	-	-	-	**-1.575** (-0.80)	**-0.481** (-0.37)	**9.236*** (1.97)	**-1.218** (-0.03)	**0.296** (0.26)	**16.932**** (2.44)
Constant	**48.848***** (10.20)	**5.169***** (2.87)	**63.979*** (1.78)	**10.775** (0.28)	**12.576** (1.53)	**199.667**** (2.24)	**29.820** (0.92)	**-15.026*** (-1.92)	**498.233***** (3.54)
Number of Observations	450	450	450	450	450	450	450	450	405
F-Test, (p-value)	106.70 (0.00)	-	-	27.09 (0.00)	-	-	57.77 (0.00)	-	-
R-Squared	0.21	0.21	-	0.21	0.18	-	0.47	0.35	-
Wald Test χ^2, (p-value)	-	10.33 (0.00)	3.22 (0.07)	-	11.57 (0.02)	94.67 (0.00)	-	189.82 (0.00)	335.92 (0.00)
Hausman test χ^2, (p-value)	96.65		-	99.64		-	82.11		-

	(0.00)			(0.00)			(0.00)		
Sargan Test χ^2, (p-value)	-	-	7.802 (0.90)			35.378 (0.36)	-	-	21.546 (0.25)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(6) -0.942 (0.35)			AR(3) -0.249 (0.80)			AR(5) 0.048 (0.96)
Number of Instrumental Variables			16			38			25

Panel B: Evaluation of the impact of Abuja policy instrument on convergence of private health expenditure as percent of total health expenditure for conditional model with interactive term (model 14) (evaluated at the mean of SSA = 9.5%, Abuja threshold =15%)		
The coefficient estimate of lagged private health expenditure as a percent of total health expenditure	**Mean**	**Threshold**
	-1.105	**-1.105**
The coefficient of interaction of private health expenditure as percent of total health expenditure and public health expenditure as a percent of government expenditure (0.067)	-0.998	-1.575
Net Convergence rate	**-2.103**	**-2.68**

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model.

2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses;

3) Where p= are the probability values.

4) The instruments: Model 12 (six period lags of private health expenditure as a percent of total health expenditure (GMM)): Model 13 (three period lags of external health expenditure as a percent of total health expenditure (GMM), one period lagged difference of private health expenditure as percent of total health expenditure (GMM) and one period lag of private health expenditure as percent of total health expenditure): Model 14 (five period lagged private health expenditure (GMM), one period lagged difference of external health expenditure as a percent of total health expenditure, one period lagged difference of private health expenditure as a percent of total health expenditure, difference of public health expenditure as a percent of government expenditure, one period lagged private health expenditure as a percent of total health expenditure).

The interactive term lagged share of private health expenditure in total health expenditure and share of public health expenditure in total government expenditure in model 14 is negative and significant. When evaluated at the mean (9.5%) of public health expenditure as a percent of government expenditure the conditional convergence rate of private health expenditure as a percent of total health expenditure was at 2.1%. But when evaluated at the Abuja target of 15% the conditional convergence rate increased to 2.68%.

5. Summary, Conclusions and Policy Implications

5.1 Summary

The main objective of this paper was to determine whether health expenditure in SSA has been converging since the Abuja declaration. Under the convergence hypothesis lower health spending countries increase their health expenditure allocation to catch up with their higher spending counterparts (Wang, 2009; Narayan, 2007). The post Abuja declaration period has been characterized by overdependence on external support as 25 SSA countries have over 25% of their total health expenditure funded by donors (World Health Organization, 2013). Second, most of the countries which have benefitted from the HIPC debt relief are the ones who have implemented the Abuja target. Third, most of the high income countries in SSA have higher per capita health expenditure but have not reached the Abuja target 10 years on with an exception of Botswana. The aim of the study was to determine whether external health resources, real income per capita and HIPC debt relief affected convergence rates of the various health expenditure measures. It also sought to determine whether the Abuja target variable, public health expenditure as a percent of government expenditure, influenced the speed of convergence of other health expenditure measures.

The study of convergence in social spending has been limited to developed countries even as social spending share of government spending in developing countries has expanded. The current study

extends the literature in several ways. First, it examines a broader set of health expenditure measures than previous studies which only considered either total health expenditure as a ratio of GDP and/or per capita health expenditure. Second, the study provides econometric evidence on convergence of health expenditure in the developing world and Sub-Saharan Africa using recent development in estimation of linear dynamic panel data (LDPD). Specifically, it applies a hybrid dynamic panel estimation technique from Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The main advantage over other estimation methods is that it takes into account dynamics and controls for endogeneity, unobserved heterogeneity and stationarity.

Third, previous studies on conditional convergence of health expenditure control only for real income per capita. The current study not only controls for real income per capita but also controls for two developments in SSA since the Abuja declaration. First, many countries became heavily reliant on external (donor) health financing. Second, some countries benefitted from HIPC debt relief. Fourth, the study provides evidence on the interaction between the Abuja policy instrument (public health expenditure as percent of government expenditure) and other health expenditure measures.

The estimates of absolute convergence indicate negative and significant coefficients of lagged public health expenditure as a percent of government expenditure, lagged real health expenditure per capita, lagged total health expenditure as a percent of GDP, lagged public health expenditure as a percent of total health expenditure and lagged private health expenditure as a percent of total health expenditure. Therefore, each of these health expenditure measures converged toward its particular steady state between 2001 and 2011. The estimates of the conditional convergence models indicate that taking into account important features of SSA relevant to health expenditure convergence of various health expenditure measures exists. In addition, conditional convergence rate of various health expenditure measures declined with increase in public health expenditure as

a percent of government expenditure, with an exception of private health expenditure as a percent of total health expenditure.

The estimates in the conditional models showed that external health expenditure as a percent of total health expenditure (donor funding) was positive but did not affect growth of public health expenditure as a percent of government expenditure and private health expenditure as a share of total health expenditure during the period 2001 to 2011. On the other hand, it contributed to increase of real per capita health expenditure, total health expenditure as a share of GDP but reduced public health expenditure as a share of total health expenditure significantly. Real income per capita in the post Abuja declaration period 2001- 2011 reduced the growth of public health expenditure as a percent of government expenditure and private health expenditure as a share of total health expenditure significantly. But it led to increased growth of real per capita health expenditure per capita, total health expenditure as a share of GDP and public health expenditure as a share of total health expenditure significantly.

Sub-Saharan Africa countries that benefitted from HIPC debt relief had a significant increased growth in public health expenditure as a percent of government expenditure, real per capita health expenditure, total health expenditure as a percent of GDP, private health expenditure as a percent of total health expenditure more than the non-beneficiaries. On the other hand, the HIPC debt relief beneficiaries had a reduced growth in public health expenditure as a percent of total health expenditure compared to their counterparts who did not benefit from the debt relief.

5.2 Conclusion

In conclusion, SSA countries with low health expenditure relative to the steady state, move toward the steady state faster than countries whose health expenditure, is not far away from the steady state. Convergence of various types of health expenditure exists even after taking into account conditional factors. External health expenditure as a percent of total health expenditure increased

the divergence of real per capita health expenditure and total health expenditure as a percent of GDP but led to convergence of public health expenditure as a percent of total health expenditure to the steady state. Real income per capita also contributed to divergence of real per capita health expenditure, total health expenditure as a percent of GDP and public health expenditure as a percent of total health expenditure. On the other hand, it lead to convergence of public health as a percent of government expenditure and private health expenditure as a percent of total health expenditure respectively. SSA countries who benefitted from HIPC debt relief diverged from the steady state of public health expenditure as a percent of government expenditure, real per capita health expenditure, total health expenditure as a share of GDP, private health expenditure as a percent of total health expenditure more than the non-HIPC countries. On the other hand, HIPC benefitting countries converged to a steady state of public health expenditure as a percent of total health expenditure more than non HIPC ones in SSA.

The increase in public health expenditure as a percent of government expenditure (Abuja policy instrument) affected the growth rate of other health expenditure measures in the period 2001-2011. The simulation at its mean (9.5%) shows that there was a decrease in the growth of real per capita health expenditure, total health expenditure as a percent of GDP, public and private health expenditure as a share of total health expenditure. Thus, there was increased convergence rate of the health expenditure measures. However, at the Abuja target (15%) the estimates showed a slower decline in the growth of health expenditure measures except for private health expenditure as a share of total health expenditure. This implies that as SSA countries implement the Abuja target other health expenditure measures variability also decrease overtime.

5.3 Policy Implications

This study results have indicated that the Abuja policy instrument of public health expenditure as a percent of government expenditure influenced movement of other pertinent health expenditure

measures towards a common equilibrium. Therefore, policy makers need to continue lobbying for its implementation across the Sub-Saharan Africa countries. This will motivate lower spending countries to catch up with the higher health spending ones in all categories of health expenditure.

The presence of convergence, provide evidence that the total, public and private health expenditure categories are trending together in SSA. The continued upward convergence of public health expenditure (increase in growth of public health expenditure between the period 2001- 2011) might have increased health service delivery and quality of life. This is through trained health personnel, availability of medical equipment and drugs and good infrastructure such as medical facilities. The downward convergence of private health expenditure (declining trends in private health expenditure in SSA in the period 2001-2011) indicates that they are decreasing and the burden of health care is shifting away from the households. This implies that vulnerability of households is decreasing. Therefore, more efforts by the policy makers are needed to increase effectiveness of public health expenditure in health service delivery in order to cushion the vulnerable in SSA.

The contribution of donor funding and HIPC debt relief to growth of some health expenditure measures in SSA shows over reliance on external sources to support our health systems. Additionally, HIPC debt relief benefitting countries showed positive growth of their health expenditure. There is need to introduced alternative and sustainable health financing mechanisms such as community based health insurance to reduce dependency on donor funding for health care and other external initiatives such as HIPC debt relief.

CHAPTER THREE

HEALTH EXPENDITURE AND CHILD HEALTH IN SUB-SAHARAN AFRICA

1. Background

Promotion of good health for children has featured prominently in international agenda. For instance, one of the Millennium Development Goals (MDGs) is to reduce child mortality rates by two-thirds in the developing world by 2015 (UN, 2000). However, this target is unlikely to be met (United Nations, 2011). Healthy children attain more education, high labour productivity as adults and therefore enhance economic growth (Amiri and Gerdtham, 2013; Belli, 2005; Stenberg, et al. 2014; DSAED, 2010). This potential benefit provides an impetus for provision of adequate health services to the children.

Since 1990, under-five mortality rates have declined across the world. Over the period 2000-2011, average under-five mortality rates across the world declined by 30% compared to 16% during the period 1990-2000 (Table 9). However, compared to other regions of the world Sub-Saharan Africa (SSA) had the highest under-five mortality rates. Additionally, large differences were observed in under-five mortality rates within SSA. West and Central Africa had the highest under-five mortality rate (132) compared to Eastern and Southern Africa (84) in 2011. Thus, despite the decrease in some countries (Table A1 in appendix) SSA is far from achieving the MDG to lower under-five mortality rates by two-thirds in 2015. Only Botswana, Cape Verde, Eritrea, Ethiopia, Liberia, Madagascar, Malawi, Mauritius, Niger, Rwanda, Senegal, Tanzania and Zambia might achieve the MDG target.

Table 9: Regional Comparison of Under-Five Mortality Rates across World Regions

Region	Under-Five Mortality rates (Deaths per 1000 live births)			MDG Target	Decline in Under-Five Mortality Rates (%)		
	1990	2000	2011	2015	1990-2011	1990-2000	2000-2011
Africa	163	141	**100**	**54**	39	13	29
Sub-Saharan Africa	178	154	**109**	**59**	39	13	29
Eastern and Southern Africa	162	135	**84**	**54**	48	17	38
West and Central Africa	197	175	**132**	**66**	33	11	25
Middle East and North Africa	72	52	**36**	**24**	50	28	31
Asia	85	65	**44**	**28**	49	24	32
South Asia	119	89	**62**	**40**	48	25	30
East Asia and Pacific	55	39	**20**	**18**	63	29	49
Latin America and Caribbean	53	34	**19**	**18**	64	36	44
Central and Eastern Europe/Commonwealth of Independent States	48	35	**21**	**16**	56	27	40
World	87	73	**51**	**29**	41	16	30

Source of Data: UN Inter-Agency (UNICEF, WHO, World Bank, UNPD and UN DESA) Child Mortality Estimation (2012).

Table 10 provides a summary of the factors that may have contributed to the decline in under-five mortality rates in SSA and corresponding quantitative indicators. The decrease in under-five mortality rates during the period 2000-2011 coincided with increases in public health spending in some SSA countries. A possible reason for the increase in health spending maybe the Abuja Declaration of 2001 that sought to increase public health spending in SSA. At the same time, there has been increased donor funding of health programmes from US$ 1.4 billion in 2002 to US$ 8.7 billion in 2010 (Wexler, et al., 2013). These interventions have reduced death from malaria (World Health Organization, 2011b); Measles and Pertussis; infectious diseases such as Cholera; and from HIV/AIDS related illnesses (UNAIDS, 2012).

Other factors which might have influenced the reduction in under-five mortality rates in the period 2000-2011 are as follows. Growth in the real income per capita which improved standard of living

Table 10: Probable Factors Influencing the Decline in Under-Five Mortality Rates in SSA

Percentage of Children Under-five Years Using Insecticide Treated Bed Nets (ITNs)	3% (2000); 23% (2006); 24% (2008); 35% (2009); 50% (2011); 53% (2012). Results: Malaria specific mortality rates decreased by about 33% in SSA in the period 2000-2010 (World Health Organization, 2011b).
Immunization Rates for Measles (%) of 12-23 months children)	53% (2000); 69% (2008); 74% (2010); *73*% (2012). Results: The number of deaths averted from measles increased from 197,900 in 2000 to 569,300 in 2010 (Simons, et al., 2012)
Pregnant Women with HIV Receiving Anti-Retroviral Therapy to Prevent Mother to Child Transmission (MTCT)	446,000(34%) in 2007; 576, 800 (45%) in 2008; 672,900 (54%) in 2009; 674,000 (50%) in 2010. Results: Number of new pediatrics cases of HIV infections reduced from 430,000 in 2009 to 390,000 in 2010 (WHO, et al., 2011).
Average Real Gross Domestic Product Growth (Annual %)	6.4% (2004-2008); 5.4% (2010); 5.3% (2011); 5.1% (2012). (World Bank, 2013)
Female Literacy (% Gross enrolment rate for Primary Education)	74.8% (2000); 79.7% (2002); 85.6% (2004); 91.5 % (2006); 94.8% (2008); 95.8% (2010). (World Bank, 2013)
Average Increase in Public Health Spending as % of Government Expenditure	0.9% (2000); 8.5% (2002); 9.2% (2004); 9.6% (2006); 9.4% (2008); 9.8% (2011); (World Bank, 2013)
Women Empowerment (proxy for ability to earn income) - (Labor Force Participation Rates %)	61.3 (2000); 62.7% (2006) ; 63.1 (2011) (World Bank, 2013)
Governance (CPIA Quality of Public Administration Rating; low=1; high=6)	Average of 2.9 (for the period 2005-2011) (World Bank, 2013)
Governance; (CPIA Transparency, Accountability and Corruption in Public Sector rating; low=1; high=6).	Average of 2.8 (for the period 2005-2011) (World Bank, 2013)
Poverty Reduction (those living under 1.25/day % of population	55.7% (2002); 52.3% (2005); 49.2% (2008); 48.5% (2010). (World Bank, 2013)

Sources of Data: Several World Malaria Reports (2008-2012); Global HIV/AIDS Response Reports (2006-2011); World Development Indicators (World Bank, 2013); WHO (Global Health Observatory, 2013).

and access to resources (Houweling et al., 2005; Anyanwu and Erhijakpor, 2007; Yaqub, et al., 2012). Improved literacy levels for mothers improves their capacity and enables them to consume and access quality health care for their children (Anyanwu and Erhijakpor, 2007). Increased participation of women in labour force enhances their earning power, therefore influencing household quality of life through good nutrition (Farag, et al., 2013). Improved quality of governance through reduced corruption levels is likely to result in efficient use of resources in the health sector (Gupta et al., 2000; Yaqub, et al., 2012).

1.1 Statement of the Problem

Despite reduction in under-five mortality rates in SSA from 154 per 1000 live births in 2000 to 109 per 1000 live births in 2011, under five mortality is relatively high in SSA compared to other regions where the rates are below 100 (UN Inter-Agency, 2012). Unless the under-five mortality rates in SSA are reduced, there are likely to affect negatively the human capital reserve and future economic gains in SSA. However, research evidence on the factors that reduce under-five mortality rates is inconclusive (Novignon, et al., 2012).

Public health expenditure is a key policy instrument expected to reduce under-five mortality rates (Anyanwu and Erhijakpor, 2007). However, previous studies relating health expenditure to reduction of child mortality have been inconclusive. Anyanwu and Erhijakpor (2007), Novignon, et al. (2012) and Issa and Ouattara (2005) found that in SSA increasing health expenditure would significantly reduce child mortality rates. Studies of other regions and those of developing countries have also provided similar evidence (Farahani, et al., 2010; Bhalotra, 2006; Houweling, et al., 2005; Muldoon, et al., 2011; Farag, et al., 2013). However, some studies did not find significant link between health expenditure and child mortality (Gupta, et al., 1999; Yaqub, et al., 2012; Gani, 2008). Thus the issue of whether public health spending has an impact on under-five mortality is still not settled.

It has been argued that poor governance is a possible explanation for ineffectiveness of public spending to reduce under-five mortality rates (Rajkumar and Swaroop, 2008). In particular, high corruption levels are likely to cause inefficiency in health service delivery. This involves embezzlement of funds, health staff absenteeism, and irregular procurement due to bribery and kickbacks, drugs and equipment pilferage and in kind payments (Lewis, 2006a; Savedoff, 2006). The average corruption perception index for Sub-Saharan Africa was 3.02 (out of a scale of 1 to 10) for the period 2000-2009 indicating that corruption is a problem in SSA (Teorell, et al, 2011). A very small number of studies examine the effect of good governance in improving child health. These studies suggested that good governance can reduce child mortality directly and by enhancing the effectiveness of public health expenditure (Yaqub, et al., 2012; Rajkumar and Swaroop, 2008; Gupta, et al., 2000; Farag, et al., 2013).

Most studies of the impact of health expenditure on child mortality do not take into account dynamics. Some have used ordinary least squares OLS (e.g. Houweling, et al., 2005; Rajkumar and Swaroop, 2008; Yaqub, et al., 2012) while others use static panel data models (e.g. Novignon, et al., 2012; Farag, et al., 2013). Few studies have examined whether the impact of health expenditure on child mortality depends on the quality of governance, that is, the interaction between health expenditure and governance. It is also not known how the effect of health expenditure on child mortality varies within SSA regions. Such information is necessary for understanding problems arising from poor governance and how they affect effectiveness of health expenditure. Additionally, investigating differences in the effectiveness of health expenditure in SSA region may provide a platform for region specific solutions to reduce child mortality.

1.2 Research Questions

The main research question addressed in this study is: Do increased health expenditure and reduced corruption significantly affect child mortality in SSA? The specific research questions addressed in this study are:

a) How does health expenditure affect under-five mortality in SSA?
b) Does the level of corruption influence effect of health expenditure on under-five mortality in SSA?
c) Are there significant regional differences in the effect of health spending and corruption on under-five mortality in SSA?

1.3 Research Objectives

The main objective of this study is to examine the relationship between health expenditure and under-five mortality and the role of governance environment within which health spending occurs in Sub-Saharan Africa.

The specific objectives of this study are:

a) To estimate the impact of health expenditure and under-five mortality in SSA.
b) To test whether effect of health expenditure on under-five mortality in SSA depends on level of corruption.
c) To examine whether there are regional differences in the relationship between health care spending, level of corruption and under-five mortality in SSA.

1.4 Contribution of the Study

This study provides new evidence on relationship between health expenditure and under-five mortality in the post Abuja declaration era. With exception of Novignon, et al. (2012) who used static models there is limited literature on relative effects of public and private health expenditure

on child mortality in SSA. Other existing studies such as Anyanwu and Erhijakpor (2007) focus only on the effects of total and public health expenditure on under-five mortality. The current study departs from existing studies in SSA by using panel data to examine the effects of corruption and how corruption levels influence effectiveness of health expenditure on under-five mortality.

The relevance of the study arises from the fact that reduction of child mortality in SSA is a priority agenda in policy makers' perspective. The MDG goal on reducing child mortality to a third of 1990 levels is still being implemented till 2015 and is not likely to be met by many SSA countries. Furthermore, reduction in under-five mortality is necessary for human capital stock, future investments and future workforce availability. Policy makers are therefore likely to benefit from the knowledge of how health expenditure has impacted on child mortality since the Abuja declaration on public health expenditure. This provides an impetus for assessment of success of the policy in improving child health in SSA over the last decade. Understanding how quality of governance especially levels of corruption has affected child mortality directly and its impact on effectiveness of public health expenditure provides a platform for controlling corruption in the health sector.

Furthermore, existing studies of the impact of health expenditure on under-five mortality rates have not examined the potential regional heterogeneity across SSA sub-regions. Given varied policies and health systems the effectiveness of health expenditure on under-five mortality in SSA is likely to differ across sub-regions. This study provides evidence on these differences. Increasing interest in regional integration makes comprehension of regional variations in effectiveness of health expenditure and quality of governance on reduction of child mortality in SSA relevant. This contributes to policy prescriptions that are focused on solving regional specific concerns on health expenditure, levels of corruption and child mortality.

Unlike previous studies for SSA this study used a larger sample. The application of the linear dynamic panel model (GMM-IV) is a departure from previous studies that use OLS, fixed effects and random effect estimators. The dynamic GMM-IV technique introduces dynamics, control for endogeneity and heterogeneity as well as ensuring stationarity. Hence more robust estimates than in the other static panel models are achieved.

This study is a benchmark for future research in SSA on health expenditure, corruption and child mortality. This is through expansion of the subject matter within region analysis (Eastern Africa, Western Africa, Central Africa and Southern Africa). Research can focus on differences in income grouping and how they allocate resource to the health sector. This is likely to inform policies relevant to reduction of under-five mortality in the long-run. Research can also focus on measures of corruption in the health sector and how it affects child mortality and effectiveness of public health expenditure when such data become available.

1.5 Organization of the Chapter

The remainder of this chapter is organized as follows; section 2, presents the literature review. Section 3, outlines the methodology used in the paper. Section 4, presents the descriptive statistics and econometric results. Section 5, presents a summary, conclusion and policy implications.

2. Literature Review

This section examines empirical literature on the effect of health expenditure and corruption levels on child mortality rates. Several studies have examined the relationship between different categories of health expenditure and child mortality using different types of data and estimation methods. The results differ across studies. Some studies found no effect of health expenditure on child mortality (e.g. Gupta, et al., 1999 (total health expenditure); Gupta, et al., 2001 (private health expenditure)). Others found limited effect (e.g. Filmer and Pritchett, 1999) and yet others have

found strong effect of health expenditure on child mortality (e.g. Houweling, et al., 2005; Bokhari, et al., 2007; Baldacci, et al., 2003; Anyanwu and Erhijakpor, 2007; Novignon, et al., 2012) .

The first strand of literature are the cross-sectional studies relating health expenditure and child mortality. These studies include Houweling, et al. (2005), Bokhari, et al. (2007), Baldacci, et al. (2003), Gupta, et al. (1999; 2001), Filmer and Pritchett (1999) and Gottret and Schieber (2006). Houweling, et al. (2005) examined the effects of public health expenditure on under-five mortality rates in a sample of 43 countries in Africa, Asia and Latin America with emphasis on differential impact among the rich and poor. OLS estimates indicated that a 10% increase in public health expenditure per capita would decrease under-five mortality rates by about 1.1% (rich) to 2.4% (poor). The weakness of this study emanates from not accounting for potential endogeneity of health expenditure in the under-five mortality equation which could occur because of reverse causality.

Using a sample of 127 developed and developing countries, Bokhari, et al. (2007) studied the link between per capita public health expenditure and under-five mortality rates. Unlike Houweling, et al. (2005) the paper controlled for endogeneity of health expenditure and real per capita GDP by using instrumental variable generalized method of moments-Heteroscedastic OLS estimator (GMM-HOLS) and Heteroscedastic Two-stage Least Squares (GMM-H2SLS). The estimated elasticities imply that a 1% increase in per capita public health expenditure reduced under-five mortality by 0.34% and 0.52% for developed and developing countries respectively. Though the study used GMM models the type of data used does not account for dynamics.

Baldacci, et al. (2003) estimated the relationship between 3-year (1996-1998) averages in public health expenditure and both infant and under-five mortality rates for 94 developing and transition economies. To account for potential endogeneity of health expenditure and heteroscedasticity in the cross-sectional data, Weighted Two stage Least Squares (WTSLS) was used. The cross-section

results indicated that an increase in public health expenditure by 1% resulted in decline of under-five mortality rate by about 0.22%. For the infant mortality rate, a rise in public health expenditure by 1% reduced it by 0.13% to 0.22% across three estimation methods (OLS, 2SLS and WTSLS). Baldacci, et al. (2003) also treated health status (infant and under-five mortality) as a latent variable and used covariance structure model to determine its relationship with government health expenditure. They found insignificant relationship between health expenditure and both infant and under-five mortality. Even when the income group of a country was taken into consideration, the coefficient of public health expenditure was still insignificant in the health status equation. The authors argued that such a model is appropriate as health status is multidimensional and unobservable and cannot be measured by health indicators.

Similarly, Gupta, et al. (1999) applied OLS and 2SLS to investigate the effects of total health spending and public spending on primary health care (public expenditure on clinics and practitioners or on preventive health) on under-five mortality rates in 50 developing countries and transition economies. They found that an increase in primary health care expenditure by 1% reduced under-five mortality rates by 0.97% and 0.95% respectively. The estimation results also indicated that total health expenditure as percent of GDP did not significantly affect under-five mortality rates. The authors identified two weakness of the study. First, non-uniform definition of primary health expenditure across countries. Second, potential correlation between the control variables measles immunization rates and adult illiteracy. Furthermore, due to inconsistencies in data the sample size used was far below the initial 50 observations (30 in OLS and 29 in 2SLS) this leaves very few degree of freedom which may affect robustness of the estimates realised in the study.

In another study, Gupta, et al. (2001) examined the separate effects of public and private health expenditure on under-five mortality rates among the poor and non-poor households in 70 countries.

The OLS estimates showed that an increase in public health expenditure per capita by 1% reduced under-five mortality rates by between 0.3% to 0.32% in the poor households. But private health expenditure had insignificant effect. For the non-poor households, the results indicated that an increase of 1% in public and private health expenditure per capita led to a decline in under-five mortality rates by 0.23% and the range of 0.28% to 0.43% respectively. Just as the Houweling, et al. (2005) study, the paper does not account for endogeneity of health expenditure and under-five mortality.

Filmer and Pritchett (1999) like Gupta, et al. (1999) applied OLS and 2SLS to examine the impact of public health spending on child and infant mortality using cross-section of 98 countries. The OLS estimates showed that an increase in public health expenditure by 1% led to a fall in under-five mortality by 0.14% at 10% significance level indicating a weak link. However, once the potential endogeneity of health expenditure was addressed through 2SLS, the effect of health spending on child mortality was insignificant. The authors do not include the effects of private health expenditure on under-five mortality.

Gottret and Schieber (2006) used several methods (OLS, Heteroscedastic OLS, 2SLS and generalized method of moment Heteroscedastic 2SLS) to investigate the relationship between government health expenditure and under-five mortality rates in 2000 for 113 countries. The OLS estimates indicated that increase in government health expenditure by 1% reduces under-five mortality by 0.17%. This result is lower than those which controlled for endogeneity (2SLS and GMM-H2SLS) which ranges from 0.34% to 0.4%.

One of the cross-sectional studies focusing on effect of corruption on provision of health services is Gupta, et al. (2000). The study analysed data averaged for the period 1985-1997 for each of 128 developed and developing countries using OLS and 2SLS. The OLS baseline estimates indicated that unit increase in corruption levels raised child mortality and infant mortality by 0.37 and 0.35

per 1000 live births respectively. When level of corruption was conditioned on income, the impact of corruption increased under-five and infant mortality by 0.13 and 0.14 per 1000 live births respectively. When endogeneity was accounted for through 2SLS unit increase in corruption levels raised child mortality by 0.10 per 1000 live births respectively. The authors concluded that lowering corruption was essential for better health outcomes.

The overall results from the cross-sectional studies are inconclusive. Some studies (Houweling, et al., 2005; Baldacci, et al., 2003; Bokhari, et al., 2007; Gupta, et al., 1999; Gottret and Schieber, 2006; Gupta, et al., 2001) have found a reducing and significant effect on under-five mortality. On the other hand, some studies such as Filmer and Pritchett (1999) even after controlling for endogeneity found insignificant relationship between public health expenditure and child mortality. In addition Gupta, et al. (2001) found insignificant link between private health expenditure and under-five mortality while Gupta, et al. (1999) found insignificant relationship between total health expenditure and under-five mortality. Gupta, et al. (2000) found a significant increase in child mortality and infant mortality when level of corruption is high. The estimated magnitudes of the effects of health expenditure on child mortality vary widely across the studies reviewed. In cross-sectional studies temporal dynamics are not accounted for because of their one period nature.

The second strand of literature are studies that used time series data to determine the relationship between health expenditure and under-five mortality. Time series studies provide a trend and temporal perspective. Such studies can be used to project future patterns of behaviour of both health expenditures and child mortality. Anand and Ravallion (1993) examined the impact of public health expenditure per capita and infant mortality rate in Sri Lanka. They used data for 1952-1981. OLS estimates showed that increasing public health expenditure per capita by 1% reduced infant mortality by about 0.33%. However, this study neither controlled for potential endogeneity of

public health expenditure in the infant mortality equation nor examined the time series properties of the data used. Thus the estimated relationship maybe spurious.

Yaqub, et al. (2012) estimated the impact of public health expenditure and governance on under-five mortality rates in Nigeria using OLS and 2SLS. The study covers 1980 to 2008. They estimated the direct effect of public health expenditure on under-five mortality and the interaction effect between public health expenditure and corruption levels. Without the interactive variable the OLS and 2SLS estimates indicate that increasing public health expenditure by 1% increases under-five mortality rates by 0.03% and 0.05% respectively. In the model with the interactive variable, the level of corruption significantly reduced under-five mortality and the interaction between public health expenditure and level of corruption is positive and significant. In the 2SLS, increasing public health expenditure by 1% at the mean of corruption level (0.78) in Nigeria raises under-five mortality rates by 0.01%. The study used small sample (30 observations) such that with several explanatory variables few degrees of freedom are available for statistical inferences. The paper does not also examine the time series properties of the data. Thus the estimation results maybe spurious.

In general time series studies do not control for unobserved heterogeneity. Second, the studies focus on a single country or region. This may impede generalisation of the study results to other countries.

The third strand of studies used panel data. The use of panel data to analyse the effect of health expenditure on child mortality presents some advantages over both cross-sectional and time series data. With panel data the number of observations increases and it is also possible to control for unobserved country specific effects.

One category of panel data studies related total and public health expenditure effects on child mortality (Anyanwu and Erhijakpor, 2007; Baldacci, et al., 2003; Gani, 2008). Anyanwu and Erhijakpor (2007) focused on health expenditure and under-five mortality rates in Africa. The study used a panel of 47 countries for the period 1999-2004. The authors applied three estimation methods, robust Ordinary Least Squares (ROLS), and robust Two-stage Least Squares (R2SLS) to account for endogeneity and fixed-effect estimator to account for unobserved heterogeneity. The paper found that an increase of 10% in per capita total health expenditure would decrease under-five mortality rates by the range of 1.7% to 6.3%. Additionally, an increase in public per capita health expenditure by 10% would reduce under-five mortality rates by the range of 1.8 % to 2.5% across the three estimation methods.

Applying a fixed effects model to data from seven Pacific Islands, Gani (2008) examined the effects of per capita public health expenditure on infant and under-five mortality for selected periods between 1990 and 2002. The fixed effects estimation was corrected for auto-regression of order one. The study found an insignificant relationship between per capita public health expenditure and under-five mortality. On the other hand, increasing per capita public health expenditure reduced infant mortality by 0.66%. This study did not control for potential endogeneity of health expenditure. The size of the sample used was small (n=28) such that with 12 explanatory variables few degree of freedoms for hypothesis testing are left.

Baldacci, et al. (2003) estimated the impact of public health expenditure on under-five mortality using two estimators; feasible generalised least squares (FGLS) and Arellano-Bond GMM-IV. The results for FGLS and Arellano-Bond indicated that an increase in public health expenditure by 1% reduced under-five mortality rates by 0.28% and 0.14% respectively. But FGLS estimates showed that increasing public health expenditure by 1% increased infant mortality by 0.06%. The strength

of this study is that it accounts for dynamics and potential endogeneity of health expenditure in the under-five mortality equations estimated by GMM.

Another category of panel data studies consider the impact of public and private health expenditure on health outcomes (example, Freire and Kajiura, 2011; Novignon, et al., 2012). Freire and Kajiura (2011) examined the link between components of health expenditure and under-five mortality in Asia-Pacific countries. A Fixed effects model was estimated using panel data for the period 1990-2009. The authors found that a 1% rise in public health expenditure reduced under-five mortality rates by 0.06%. A 1% increase in private health expenditure reduced under-five mortality rates by 0.10%. However, the study does not account for potential endogeneity of public and private health expenditure in the estimated under-five mortality equation.

Similarly, Novignon, et al. (2012) studied the effects of public and private health care expenditure on infant mortality rates in a panel of 44 Sub-Saharan Africa countries for the period 1995-2010 using fixed effect model. The results indicated that a 1% increase in total health expenditure reduced infant mortality by about 3 per 1000 live births. The results further show that increasing public and private health expenditure by 1% reduced mortality rates by 4.2 and 2.5 per 1000 live births respectively. A drawback of these results is that potential endogeneity of the health expenditure variables in both infant and under-five mortality equations was not taken into account.

A third group of panel data studies examined the effect of governance measures on health outcomes (Rajkumar and Swaroop, 2008; Farag, et al., 2013; Hu and Mendoza, 2013). This emerging literature examined the role of governance environment on the effectiveness of health expenditure. Rajkumar and Swaroop (2008) investigated the relationship between public health expenditure and under-five mortality rates and how governance (corruption and quality of bureaucracy) affects the relationship. The study used a three year panel data (1990, 1997, and 2003) covering 91 developed and developing countries. Pooled OLS estimates indicated that a 1% increase in public health

expenditure reduced under-five mortality by 0.18%. In the equation containing the interaction of public health expenditure and level of corruption, the public health expenditure estimate is insignificant while the interaction variable is negative and significant. However, the estimates may be biased as potential endogeneity of health expenditure in the child mortality equation was not controlled for.

In Farag, et al. (2013) a link between health expenditure, infant and child mortality, and the role of governance in low and middle income countries is investigated. The paper applied fixed effect method of estimation to a panel of 133 countries for the years 1995, 2000, 2005 and 2006. The estimates showed that a 1% increase in total health expenditure reduced under-five mortality by the range of 0.15% to 0.38%. On the other hand, it lowered infant mortality by the range of 0.13% to 0.33%. Increasing government health expenditure reduced under-five mortality by a percentage ranging from 0.1 to 0.19 while private health expenditure reduced it from the range of 0.07% to 0.08%. Additionally, a rise in government health expenditure by 1% led to a decline in infant mortality ranging from 0.08% to 0.17%, while increasing private health expenditure by 1% reduced infant mortality by the range of 0.05% to 0.07% respectively. The estimation results indicated that improving the level of government effectiveness[8] reduced child mortality. The full effect of government health expenditure with respect to improved government effectiveness (evaluated at the mean) led to a reduction of under-five mortality ranging from 0.07% to 0.12%. However, the fixed effect estimator does not take into account potential endogeneity of health expenditure in both infant and under-five mortality equations.

Hu and Mendoza (2013) applied both fixed effects and 2SLS methods to investigate the link between public health expenditure and child mortality for 136 countries over the period 1960 to

[8] Is a variable that measures the ability of the government to implement socially sound policy, that is, the level and quality of public service provision and smooth function of the bureaucracy (Kauffmann and Kraay, 2006; Farag, et al., 2013).

2005. In the fixed effect model, a 1% increase in public health expenditure as a share of GDP reduced under-five mortality by 0.11%, while the interaction of public health expenditure and control of corruption was insignificant. Fixed effects estimates showed corruption coefficient was insignificant. The 2SLS was used to handle potential endogeneity of public health expenditure. The estimated effect however, was not significant.

2.1 Summary and Conclusion

The literature on the relationship between health expenditure and child mortality has not yet come to a consensus. The problem arises because of uncertainty in the estimated effects of public health expenditure. The uncertainty can be attributed to use of different data types, inconsistent data, accounting or not accounting for endogeneity of health expenditure and unobserved heterogeneity in the methods of estimation. This study contributes to the debate by using a rich panel data set for SSA and linear dynamic panel model. It estimates the impact of various measures of health expenditure (total, public and private health expenditure) and governance on under-five mortality rates. The study also examines regional variations in how health expenditure and its interaction with governance affects under-five mortality in SSA.

3. Methodology

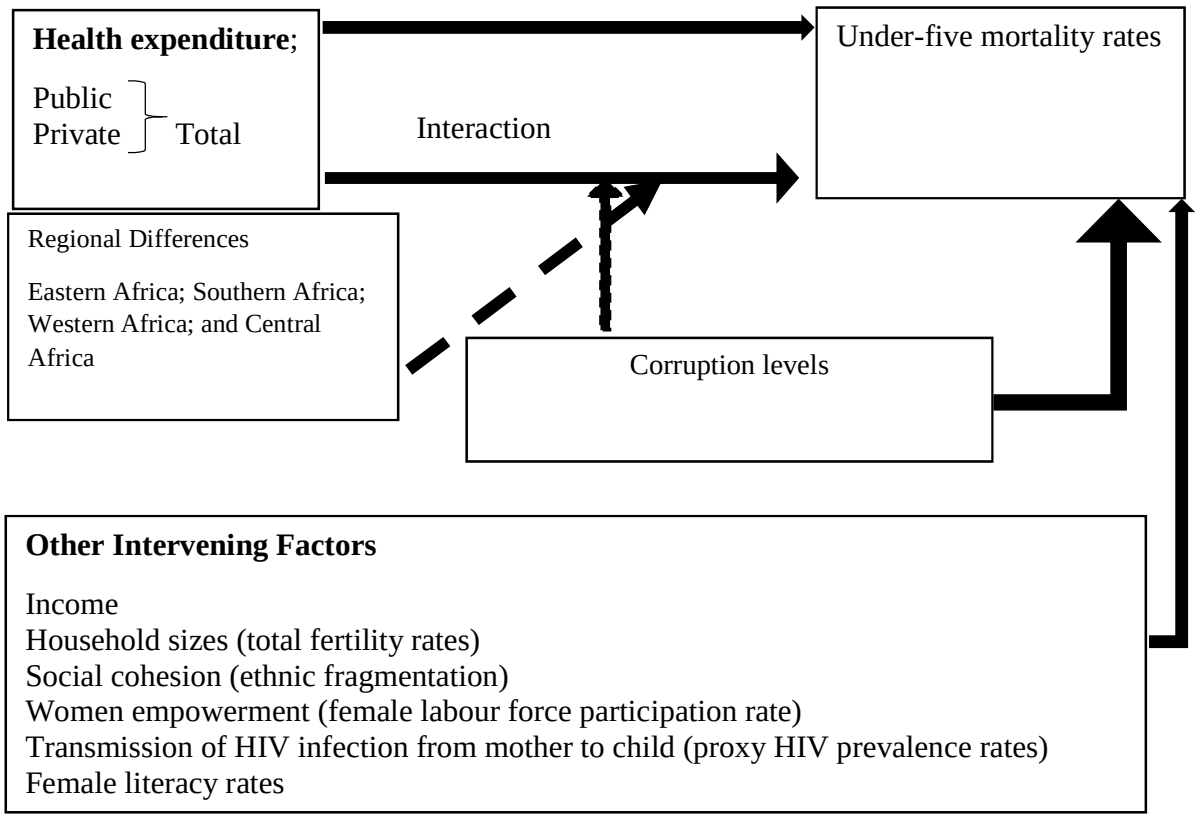
3.1 Conceptual Model for Health Expenditure, Corruption and Child Health

Conceptually health spending is a function of the health system which enables the purchase of health goods and services. Increased allocation of health resources (especially, financial resources) by the government and private sector is likely to influence the quality of health service delivery. The conceptual model is summarized in Figure 1.

The improved health service delivery results in incremental effect on the quality of life and health capital to the beneficiaries (Grossman, 1972). This in turn leads to low mortality rates in children. Suppose the government invests the increased financial resources in child immunization (for

instance, Measles); HIV/AIDS health programmes such as behavioural change education, antiretroviral therapy (ART), provision of condoms and post-exposure prophylaxis; or family planning services to reduce fertility rates.

Figure 1: Conceptual Model for Health Expenditure, Corruption and Under-Five Mortality



Source: Author (motivated from theoretical models of; Rajkumar and Swaroop (2008), Filmer and Pritchett (1999) and Yaqub, et al., 2012).

Curbing corruption increases transparency and accountability, thereby increasing effectiveness of health resources allocated to health. Lewis (2006a) identified issues such as absenteeism of health staff, bribery for services, leakage such as stealing of medical supplies as constituting most of the corruption in the health sector. Suppose we consider, the continuous presence of staff in the health care facilities, availability of drugs in the clinics would improve service delivery. This improved health service delivery would improve health of the beneficiaries which would lead

to low child and adult mortality. Reduced embezzlement and diversion of health funds to other non-priority areas is likely to improve effectiveness of health spending. This is because the resources are employed where they are most needed. This would result in adequate health services which would eventually lead to low mortality rates.

Regional differences may also influence effectiveness of health expenditure in reduction of adult mortality. This is because they have varied health policies and priorities which are likely to influence child and adult health in different ways. The regions in the conceptual model are Eastern Africa, Western Africa, Southern Africa and Central Africa which are classified using United Nation country classification system (United Nations Statistics Division, 2013).

3.2 Theoretical Model

The health production function for estimating the relationship between health expenditure, corruption and child health is adapted from Rajkumar and Swaroop (2008), Filmer and Pritchett (1999) and Yaqub, et al. (2012). The relationship can be expressed as follows.

$$\boldsymbol{CH = f\,(HEXP, RGDPC, COR)} \quad \text{.....(3.1)}$$

Where CH is under-five mortality rates. $RGDPC$ is real Gross Domestic Product per capita (real income per capita); $HEXP$ is health spending (total, public and private health care spending). COR is the level of corruption. A is assumed to be technological changes, which are assumed to be constant. From Equation (3.1) the model assumes that; increase in real per capita GDP leads to a reduction in under-five mortality rates. The mechanisms through which real income per capita affects child health are: allocation of more financial resources to child health services. Health expenditure influences child health through the following channels: availability of child health focused interventions such as immunization, nutrition boosters and supplements and, child growth monitoring. Health expenditure also facilitates availability of adequate health workers, drugs and

medical supplies and infrastructure (clinics and hospitals) for provision of the child health related health services. Improving quality of governance by reducing corruption leads to a decline in under-five mortality rates. Low corruption environment is likely to promote transparency and accountability in provision of health services. Hence, reducing leakages which might affect effectiveness of health service delivery to children.

Model (3.1) is transformed in a Cobb-Douglas health production model. The production function relates health status with health spending and real gross domestic product (GDP) per capita. It is augmented with corruption variable and this relationship is expressed as equation (3.2)

$$\boldsymbol{CH_{it} = A(RGDPC_{it})^{\alpha} * (HEXP_{it})^{\beta} * (COR_{it})^{\sigma}} \quad \text{……………………………………………………..(3.2)}$$

Taking the logarithms of equation 3.2 transforms it into a linear equation (3.3).

$$\boldsymbol{\ln CH_{it} = \ln A + \alpha \ln RGDPC_{it} + \beta \ln HEXP_{it} + \sigma \ln COR_{it}} \quad \text{……………………………...(3.3)}$$

The parameters are defined as follows: α is the coefficient of real GDP per capita; which measures the elasticity of under-five mortality rates with respect to change in income. β is the elasticity of under-five mortality rates with respect to change in health expenditure and σ is the elasticity of under-five mortality rates with respect to change in level of corruption. In equation 3.3 additional assumption is taken into consideration. The study assumes that some part of health spending (total, public and private) is lost or wasted due to corruption. This wastage has consequences on the effectiveness of health spending in a given country or region.

Following Yaqub, et al. (2012) and Pritchett (1996) and assuming $\theta(.)$ is a part of resources allocated to health that is spent on productive purposes, the β coefficient of health spending on, say programme k takes the form;

$$\boldsymbol{\beta = \pi(.) * \beta_k} \quad \text{…………………………………………………………………………….. (3.4)}$$

Where β_k represents the productivity of public or private capital that is created from spending on health programme k. Assuming that $\pi(.)$ measures the effectiveness of health spending which is a function of level of corruption $\boldsymbol{COR_{it}}$, then,

$$\boldsymbol{\pi = \theta_0 + \theta_1 COR_{it}} \quad (3.5)$$

Substituting equations (3.4) and (3.5) into (3.3) results into the following equation;

$$\boldsymbol{ln\,CH_{it} = lnA + \propto ln\,RGDPC_{it} + \beta_k(\theta_0 + \theta_1 COR_{it})\,ln\,HEXP_{it} * + \sigma\,ln\,COR_{it}} \quad (3.6)$$

Breaking down equation (3.6) leads to equation (3.7)

$$\boldsymbol{ln\,CH_{it} = lnA + \propto ln\,RGDPC_{it} + \beta_1 lnHEXP_{it} + \beta_2 COR_{it} * ln\,HEX_{it} + \sigma\,ln\,COR_{it}} \quad (3.7)$$

Where β_1 is the coefficient of the log of health expenditure and β_2 is the coefficient of the interaction of corruption index and log of respective health expenditure.

3.3 Empirical Models

In order to investigate the impact of health expenditure on under-five mortality rates, three models are specified. The first model contains health expenditure and a set of control variables. This is the baseline model to study the relationship between health expenditure and under-five mortality rates. It is written as follows.

$$\boldsymbol{lnCH_{it} = \alpha_0 + \alpha_1 lnHEXP_{it} + ln\,Z'_{it}\Psi + \mu_{it}} \quad (3.8)$$

The model in equation (3.8) was extended to include the corruption perception index to yield the following model.

$$\boldsymbol{lnCH_{it} = \tau_0 + \tau_1 lnHEXP_{it} + \tau_2 lnCOR_{it} + ln\,Z'_{it}\Psi + v_{it}} \quad (3.9)$$

In order to investigate how level of corruption influences the effect of health expenditure on child mortality equation (3.9) was extended with interaction between health expenditure and corruption, to yield.

$$\boldsymbol{ln\,CH_{it}} \; = \; \boldsymbol{\gamma_0} + \boldsymbol{\gamma_1 lnHEXP_{it}} + \boldsymbol{\gamma_2 lnCOR_{it}} + \boldsymbol{\gamma_3 [COR_{it} * lnHEXP_{it}]} + \boldsymbol{ln\,Z'_{it}\Psi} + \boldsymbol{\varepsilon_{it}} \quad \text{.........(3.10)}$$

The equations (3.8), (3.9) and (3.10) relates natural log of under-five mortality rates ($\boldsymbol{ln\,CH_{it}}$) to the natural log of health expenditure ($\boldsymbol{lnHEXP_{it}}$), the natural log of corruption index ($\boldsymbol{lnCOR_{it}}$), the interaction between the natural log of health expenditure and corruption index ($\boldsymbol{COR_{it} * lnHEXP_{it}}$), and a vector of control variables. Z_{it} are control variables which include: the natural log of real GDP per capita, total fertility rates, HIV prevalence rates, the natural log of ethnic fragmentation, measles immunization rates, the natural log of female literacy and female labour force participation rate.

The coefficients α_1, β_1 and γ_1 are the coefficient estimates of health spending and are expected to be negative. β_2 and γ_2 are coefficients of level of corruption and are expected to be negative. γ_3 is the coefficient of the interaction term and can take positive or negative sign. Ψ is the coefficient for the vector of control variables. μ_{it} , v_{it} and ε_{it} are the composite error terms which consists of country specific effects and time-specific effects. The composite error terms are assumed to be normally distributed and homoscedastic.

In order to investigate regional differences in effects of health expenditure and corruption on under-five mortality rates equations (3.8), (3.9) and (3.10) are extended to include dummy variables of SSA sub regions and their interactions with health expenditure and level of corruption.

The baseline model to test for regional differences in the effects of total health expenditure on under-five mortality rates is written as follows.

$$lnCH_{it} = \alpha_0 + \alpha_1 lnHEXP_{it} + \alpha_2 EA_i + \alpha_3 CA_i + \alpha_4 WA_i + \alpha_5[EA_i * lnHEXP_{it}] + \alpha_6[CA_i * lnHEXP_{it}] + \alpha_7[WA_i * lnHEXP_{it}] + ln\, Z_{it}'\Psi + \kappa_{it} \ldots\ldots\ldots\ldots\ldots\ldots (3.11)$$

When level of corruption and interactions with the regional dummy variables are included the model is as follows.

$$lnCH_{it} = \beta_0 + \beta_1 lnHEXP_{it} + \beta_2 EA_i + \beta_3 CA_i + \beta_4 WA_i + \beta_5[EA_i * lnHEXP_{it}] + \beta_6[CA_i * lnHEXP_{it}] + \beta_7[WA_i * lnHEXP_{it}] + \beta_8 lnCOR_{it} + \beta_9[EA_i * lnCOR_{it}] + \beta_{10}[CA_i * lnCOR_{it}] + \beta_{11}[WA_i * lnCOR_{it}] + ln\, Z_{it}'\Psi + \omega_{it} \ldots (3.12)$$

Further extension introduces interaction between regional health expenditure and corruption to obtain the following model.

$$lnCH_{it} = \gamma_0 + \gamma_1 lnHEXP_{it} + \gamma_2 EA_i + \gamma_3 CA_i + \gamma_4 WA_i + \gamma_5[EA_i * lnHEXP_{it}] + \gamma_6[CA_i * lnHEXP_{it}] + \gamma_7[WA_i * lnHEXP_{it}] + \gamma_8 lnCOR_{it} + \gamma_9[EA_i * COR_{it} * lnHEXP_{it}] + \gamma_{10}[CA_i * COR_{it} * lnHEXP_{it}] + \gamma_{11}[WA_i * lnCOR_{it} * lnHEXP_{it}] + ln\, Z_{it}'\Psi + \varrho_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.13)$$

Equations (3.11), (3.12) and (3.13) relates natural log of health expenditure, regional dummy variables Eastern Africa (EA), Central Africa (CA), Western Africa (WA), interaction of regional dummy variables and natural log of health expenditure, interactions of regional dummy variables and natural log of level of corruption and the interactions of regional dummy variables, levels of corruption and natural log of health expenditure. The Southern Africa (SA) dummy variable and its interactions are dropped from the model to avoid the dummy variable trap. κ_{it}, ω_{it} and ϱ_{it} are composite error terms for the respective equations.

3.4 Variables Definition and Data Sources

This section describes the data used in the child health regressions. Table 11 presents the variables names (Column 1), a short description of the variable (column 2) and the source of data for each variable (column 3).

Table 11: Data Sources and Definition of Variables

Variable Name	Description	Data Source
Under-five mortality rate	Under-five mortality rate is the probability per 1,000 live births that a new-born baby will die before reaching age five, if subject to current age-specific mortality rates. This variable in specified in natural logarithm form.	World Development Indicators (World Bank, 2011)
Public Health Expenditure	Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds. Measured as the total public health expenditure. Measured in US$ millions.	World Development Indicators (World Bank,2011); WHO National Health Accounts, 2013
Private Health Expenditure	Private health expenditure includes direct household (out-of-pocket) spending, private insurance, charitable donations, and direct service payments by private corporations. Measured as total private health expenditure. Measured in US$ millions	World Development Indicators (World Bank,2011) ;WHO National Health Accounts (2013)
Total Health Expenditure	Total health expenditure is the sum of public and private health expenditures. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation. Measured in US$ millions.	World Development Indicators (World Bank,2011); WHO National Health Accounts (2013)
Real GDP per Capita	GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international US$ using purchasing power parity rates. Data are in constant 2005.	World Development Indicators (World Bank, 2011)
HIV Prevalence Rate	Prevalence of HIV refers to the percentage of people aged 15-49 that are infected with HIV.	World Development Indicators (World Bank, 2011)
Total Fertility Rate	Total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates. (proxy for household size)	World Development Indicators (World Bank, 2011)
Measles immunization rates	Child immunization measures the percentage of children aged 12-23 months who received vaccinations before 12 months or at any time before the survey. A child is considered adequately immunized against measles after receiving one dose of vaccine.	World Development Indicators (World Bank, 2011)

Ethnic Fragmentation	Reflects probability that two randomly selected people from a given country will not belong to the same ethno linguistic group. The higher the number, the more fractionalized is the society. The definition of ethnicity involves a combination of racial and linguistic characteristics. It's a proxy for social capital	University of Gothenburg (Quality of Governance Institute).(2011)
Transparency International-Corruption Perception Index	The CPI focuses on corruption in the public sector and defines corruption as the abuse of public office for private gain. The surveys used in compiling the CPI tend to ask questions in line with the misuse of public power for private benefit, with a focus, for example, on bribe-taking by public officials in public procurement. The sources do not distinguish between administrative and political corruption. The CPI Score relates to perceptions of the degree of corruption as seen by business people, risk analysts and the general public and ranges between 10 (highly clean) and 0 (highly corrupt).	University of Gothenburg (Quality of Governance Institute) (2011)
Female Literacy	Female gross enrolment ratio is the ratio of total enrolment for primary education, regardless of age, to the population of the aged group that officially corresponds to the level of education shown. This is a basic measure for literacy as ability to read, write and speak. A proxy for female literacy.	World Development Indicators (World Bank, 2011)
Female Labour Force Participation Rate (FELP)	Female labour force as a percentage of the total shows the extent to which women are active in the labour force. Labour force comprises people of ages 15 and older who meet the International Labour Organization's definition of the economically active population.	World Development Indicators (World Bank, 2011)

3.5 Estimation

Health expenditure could be potentially endogenous in under-mortality equations in the presence of measurement errors, omitted variables and reverse causality. For instance, economic adjustments, changes in population characteristics and political regime changes or upheavals are likely to be omitted variables correlated with health expenditure. Other concerns are problems of unobserved heterogeneity and lagged dependent variable in dynamic models. Estimation under these statistical challenges can produce inconsistent and biased estimates. Therefore an econometric strategy based on dynamic panel estimators was used to allow for instrumental variables. Specifically, the Generalized Method of Moments instrumental variable linear dynamic panel model was used. Linear Dynamic Panel Data (LDPD) is a hybrid model emanating from works of Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). It

combines the properties of the Arellano-Bond GMM and Systems GMM estimators. The specified models were estimated using instruments in both differences and levels. Diagnostic tests for validity of instruments (Sargan test), overall significance of explanatory variables (Wald test) and autocorrelation (Arellano-Bond tests) were carried out.

4. Empirical Results

4.1 Descriptive Statistics

This section presents the descriptive statistics for all variables used in the study. Table 12 shows the mean under-five five mortality rate was 114.9 per 1000 live births across 41 SSA countries. The average public health spending was about US$ 759 million (2000, constant). Average private health care spending was higher at US$ 1,130 million. This shows that total health care spending at US$ 1,890 million, would hide the observation that private health expenditure is almost one and half times public health expenditure.

Table 12: Descriptive Statistics for Various Indicators in Sub-Saharan Africa over the Period 2001-2009

Variable	Obs	Mean	Std. Dev	Min	Max
Under-five mortality rate (UMR) per 1000 live births	410	114.9	43.6	13.5	217.8
Public Health Expenditure (Million US$ Constant 2000)	410	759	2,160	4.98	15,700
Private Health Expenditure (Million Constant 2000 US$)	410	1,130	3,490	7.4	23,500
Total Health Expenditure (Million US $, Constant, 2005)	410	1890	5,620	14.1	39,200
Real GDP per Capita (Constant. 2005 , PPP US$)	409	3259.4	4998.2	346.1	31738.2
HIV Prevalence Rate (%)	370	6.2	7.1	0.1	26.3
Measles immunization rates (%)	410	71.6	17.6	17	99
Total Fertility Rate (No of Children per Woman)	410	4.87	1.21	1.5	7.5
Ethnic Fragmentation	410	0.63	0.23	0.01	0.93
Transparency International-Corruption Perception Index	276	3.02	1.06	1	6.4
Female Literacy	410	92.1	27.3	26.5	152.5
Female Labor Force Participation Rate (%)	400	62.7	16.0	28.9	91

Out-of-pocket health spending is the largest component of private health care spending. In 28 countries, it is about 70% of private health care spending. This suggests that many inhabitants of SSA are vulnerable to poverty when faced by high health expenditures. Mean Corruption Perception Index was 3.02. Because a corruption index of one denotes high corruption and corruption index of ten denotes low corruption, a corruption index of three indicates that corruption was rampant in most of the SSA countries over the period covered.

Average real GDP per capita was US$ 3,259.4 (PPP, 2005 International) with a large standard deviation. The average HIV prevalence rate was about 6.2% but in one country it was 26.3%. On average, SSA had 4.9 children per woman (a proxy for household size), and female labour force participation averaged 62.7% of the economically active population. Average female literacy measured as primary school gross enrolment ratio in Sub-Saharan was at 92.1. However, Niger had very low female literacy rates at 26.5. The average ethnic fragmentation index (a proxy for social cohesion) was 0.63 (maximum possible index is 100). This indicates that ethnic fragmentation is high in Sub-Saharan Africa.

4.2 Econometric Results: Health Spending, Corruption and Under-Five Mortality Rates in Sub-Saharan Africa

This section presents the econometric results for the effects of health care spending and level of corruption on under-five mortality rates in Sub-Saharan Africa. The results are presented in sections 4.2.1 and 4.2.2 respectively. The estimation results of equations (3.8), (3.9) and (3.10) are presented in this section. In the remainder of this study, the interpretation of the results is based on linear dynamic panel GMM model estimates.

4.2.1 Total Health Expenditure, Corruption and Under-Five Mortality Rates

Table 13 shows the estimated effects of total health expenditure and corruption on under-five mortality rates. Model 1, is baseline model measuring the effects of total health expenditure on

Table 13: Effects of Total Health Expenditure and Corruption on Under-Five Mortality Rates (Dependent Variable is the ln (Under-Five Mortality Rates))

Independent Variables	Model 1			Model 2			Model 3		
	FE	RE	LDPD	FE	RE	LDPD	FE	RE	LDPD
ln(Total health expenditure)	**-0.111*** (-4.17)**	**-0.069*** (-3.48)**	**-0.136*** (-4.96)**	**-0.006 (-0.18)**	**-0.085 *** (-3.72)**	**-0.102*** (-5.23)**	**-0.018 (-0.54)**	**-0.097*** (-4.18)**	**-0.433*** (-4.35)**
ln(Real Gross Domestic Product per Capita)	**-0.104** (-2.21)**	**-0.120*** (-3.37)**	**-0.275*** (-7.07)**	**-0.632*** (-7.30)**	**-0.234 *** (-4.30)**	**-0.300*** (-8.57)**	**-0.615*** (-7.08)**	**-0.227*** (-4.23)**	**-0.136* (-1.88)**
ln(Female literacy)	**-0.003 (-0.07)**	**0.016 (0.46)**	**1.046*** (4.82)**	**0.056 (1.22)**	**0.031 (0.67)**	**0.819*** (5.24)**	**0.046 (1.00)**	**0.021 (0.45)**	**0.729*** (3.80)**
Female labour force participation rate	**-0.014 ** (-2.14)**	**-0.004 (-1.56)**	**-0.015*** (-5.00)**	**-0.016 * (-1.87)**	**-0.009*** (-3.06)**	**-0.016*** (-6.44)**	**-0.016 * (-1.89)**	**-0.008*** (-2.93)**	**-0.018*** (-6.36)**
Total fertility rate	**0.171*** (4.55)**	**0.248*** (10.18)**	**0.362*** (20.63)**	**0.213*** (4.25)**	**0.289*** (8.77)**	**0.287*** (24.37)**	**0.212*** (4.24)**	**0.292*** (8.98)**	**0.274*** (14.73)**
HIV prevalence rate	**0.043*** (6.51)**	**0.029*** (6.61)**	**0.063*** (6.67)**	**0.074*** (10.48)**	**0.047*** (9.45)**	**0.069*** (8.16)**	**0.072*** (10.17)**	**0.045*** (8.95)**	**0.071*** (7.98)**
Measles immunization rate	**0.0003 (0.45)**	**-0.0003 (-0.51)**	**-0.009*** (-13.04)**	**0.0003 (0.35)**	**-0.0003 (-0.45)**	**-0.010*** (-16.47)**	**0.0003 (0.41)**	**-0.0003 (-0.37)**	**-0.0003 (-0.09)**
ln(Ethnic fragmentation)	-	**0.093* (1.80)**	**0.189*** (4.82)**	-	**0.127** (2.20)**	**0.190*** (5.51)**	-	**0.123** (2.17)**	**1.473*** (3.55)**
ln(Corruption Index)	-	-	-	**-0.034 (-0.97)**	**-0.081** (-2.20)**	**-0.113** (-2.22)**	**-0.185* (-1.82)**	**-0.310*** (-2.81)**	**-1.197** (-2.20)**
Corruption Index * ln (Total health expenditure)	-	-	.-	-	-	-	**0.003 (1.59)**	**0.004** (2.20)**	**0.017** (2.27)**
Constant	**7.438*** (9.32)**	**5.377*** (10.97)**	**3.458*** (14.12)**	**8.732*** (7.74)**	**6.452*** (9.69)**	**4.426*** (14.84)**	**8.889*** (7.88)**	**6.640*** (10.00)**	**4.694*** (5.63)**

Number of Observations	370	370	370	255	255	255	255	255	255
F-Test, (p-value)	71.49 (0.00)	-	-	90.55 (0.00)	-	-	81.34 (0.00)	-	-
R-Squared	60.55		-	77.36	73.98	-	77.63	74.33	-
Wald Test χ^2, (p-value)	-	535.31 (0.00)	11764.96 (0.00)		582.96	15583.25 (0.00)		594.31 (0.00)	16290.93 (0.00)
Hausman test χ^2, (p-value)	21.95 (0.00)		-	39.46 (0.00)			34.36 (0.00)		
Sargan Test χ^2, (p-value)			10.499 (0.94)			21.129 (0.33)			12.086 (0.74)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(2) 1.202 (0.23)			AR(2) -0.266 (0.79)			AR(2) 0.581 (0.56)
Number of Instrumental Variables			28			29			27

Notes: (1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model.
(2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses.
(3) Where p= are the probability values,
(4) ***, **, * represent significance levels of 1%, 5% and 10% respectively.
(5) Instruments:
Model 1 (four years lagged ln (under-five mortality rate) (GMM), differences of total fertility rate, ln (real income per capita), female labour participation rate, measles immunization rate and ln (ethnic fragmentation); levels, total fertility rates, ln (real income per capita), female labour force participation rate, measles immunization rate, ln (ethnic fragmentation) and ln (total health expenditure):

Model 2 (four period lagged ln (under-five mortality rate) (GMM), differences of log (corruption index), total fertility rate, ln (real income per capita), female labour force participation rate, measles immunization rate, ln (ethnic fragmentation) and the ln (total health expenditure): levels, total fertility rate, ln (real income per capita), female labour force participation rate, measles immunization rate, ln (ethnic fragmentation) and the ln (total health expenditure).

Model 3 (four period lagged ln (under-five mortality rate) (GMM); differences of ln (real income per capita) and female labour force participation: levels, levels, ln (real income per capita), female labour force participation rate, total fertility rate, ln (total health expenditure) and the measles immunization rate.

Under-five mortality rates. Model 2, has an additional variable measuring the effect of corruption on under-five mortality rates. Model 3, determines the effectiveness of total health expenditure on under-five mortality rates with respect to change in corruption level. This is achieved by adding an interaction between level of corruption and health expenditure.

The diagnostic tests used for model 1 to 3 of the linear dynamic panel are the Wald criterion, Sargan test and Arellano-Bond autocorrelation test. Wald test in all the three models is significant at 1% rejecting the null hypothesis that there is no joint significance of the coefficients. The p-value for the Arellano-Bond test are large indicating that the null of no serial correlation in the first difference errors cannot be rejected. Sargan test for over-identification restriction validity show that the null hypothesis cannot be rejected. Thus instruments used in three GMM models are valid.

The estimated coefficient of total health spending in model 1 of Table 13, is negative and significant at 1% level. An increase in total health spending by 1% would reduce under-five mortality by about 0.14% annually in SSA. This result is consistent with that of Anyanwu and Erhijakpor (2007) and Farag, et al. (2013). But it differs from that of Gupta, et al. (1999) who found a positive but insignificant effect of total health expenditure on under-five mortality rates. However, these studies used different models from the one used in the study. The estimated coefficients of the control variables also show significant and correct signs in model 1. The exception is female literacy coefficient which is positive and significant. This may imply that as more female are getting educated they are likely to work away from home. Consequently, they delegate caring of their children to third party reducing the motherly attention (such as, providing emergency health care when children are ill unexpectedly) which is crucial for children under-five years.

Model 2 repeats the estimation but includes natural log of corruption index. The coefficient of total health spending is negative and significant but of smaller absolute magnitude. Increasing total health spending by 1% decreases under-five mortality rate by about 0.1%. The coefficient of natural

log of corruption perception index is negative and significant. A 1% increase in the corruption index (increase implies lower levels of corruption) decreases under-five mortality by about 0.11%. The results are consistent with those of Yaqub, et al. (2012). In contrast, Hu and Mendoza (2013) and Rajkumar and Swaroop (2008) found positive and insignificant impact of corruption perception index on under-five mortality. Gupta, et al (2000) found a positive relationship between corruption (where 1; low corruption and 10; high corruption) and child mortality. The control variables still have expected signs and significantly influence under-five mortality rates. However, the sign of female literacy is still positive.

The estimation results under Model 3 include the interaction term between level of corruption and health expenditure. The estimated coefficient of total health expenditure, level of corruption and the interaction term are significant. The control variables exhibit the expected signs (except for female literacy) and are all significant (except for measles immunization rate) determinants of under-five mortality rates. Table 14 displays the derived estimates of effectiveness of total health expenditure on under-five mortality rates. The estimated coefficient of total health expenditure and that of the interactive variable were used to compute the effectiveness of total health expenditure evaluated at the minimum, maximum and mean values of the corruption perception index.

Table 14: Effectiveness of Total Health Expenditure on Under-Five Mortality Rates in Sub-Saharan Africa Based on Estimates of Linear Dynamic Panel Model

Corruption Perception Index	**Mean**	**Min**	**Max**
	3	**1**	**6.4**
Coefficient of ln (Total health expenditure)	-0.433	-0.433	-0.433
Coefficient of corruption Index*ln(total health expenditure)	0.051	0.017	0.109
Net Effect	**-0.382**	**-0.416**	**-0.324**

Calculations based on estimates in Model 3 of Table 13.

Table 14 indicates that when level of corruption is perceived to be high (CPI =1), increasing total health spending by 1% reduce under-five mortality rate by about 0.42%. But when level of

corruption is perceived to be low (CPI =6.4), 1% increase in total health spending decreases under-five mortality rates by about 0.32%.

The lower effectiveness of total health expenditure on under-five mortality when corruption is perceived to be low than when it is perceived to be high could imply seekers of health service may be willing to participate in corruption to receive health care service (Gupta, et al., 2000). Subsequently, health sector personnel who control resources are likely to perpetuate corruption (Vian, 2008; Lewis, 2006b). If they are motivated to work better in a highly corrupt environment there is a likelihood of lower child mortality.

4.2.2 Public and Private Health Expenditure, Corruption and Under-Five Mortality Rates

Econometric results of the effect of public and private health spending and, corruption on under-five mortality rates are shown in Table 15. The results are displayed in three models. The baseline model (Model 4) includes public and private health expenditure and the set of control variables. Modell 5 extends model 4 by including corruption perception index to measure the effect of corruption on under-five mortality rates. Model 6 includes all variables in model 5 and adds interaction terms between corruption index and natural log (public health expenditure) and, between corruption index and natural log (private health expenditure). The aim is to determine the effectiveness of both public and private health expenditure on under-five mortality rates.

The p-value (0.00) for Wald test indicate that the null hypothesis of no joint significance in the coefficient estimates can be rejected. The Arellano-Bond test for autocorrelation shows that the null hypothesis of no serial correlation cannot be rejected as the p-values are more than 0.10. The p-value of Sargan test shows the over-identification restrictions are valid. Thus, the instruments used are valid.

The results for model 4 show that coefficient of public health expenditure is negative and significant while that of private health spending is positive and insignificant. Increasing public

Table 15: Effects of Public and Private Health Expenditure and Corruption on Under-Five Mortality (Dependent Variable is the ln (Under-Five Mortality Rates))

Independent Variables	Model 4			Model 5			Model 6		
	FE	RE	LDPD	FE	RE	LDPD	FE	RE	LDPD
ln(Public health expenditure)	-0.073*** (-3.72)	-0.063*** (-3.49)	-0.238*** (-3.65)	-0.056*** (-2.68)	-0.105*** (-5.41)	-0.128*** (-2.64)	-0.073* (-1.88)	0.023 (0.58)	0.174** (1.99)
ln(Private health expenditure)	-0.028 (-1.15)	0.002 (0.10)	0.076 (1.54)	0.067*** (2.73)	0.021 (1.04)	0.018 (0.43)	-0.093** (-2.08)	-0.131*** (-2.97)	-0.328*** (-3.35)
ln(Real Gross Domestic Product per Capita)	-0.112** (-2.37)	-0.117*** (-3.26)	-0.222*** (-6.12)	-0.611*** (-7.24)	-0.223*** (-4.10)	-0.222*** (-7.29)	-0.643*** (-7.81)	-0.258*** (-4.78)	-0.442*** (-3.45)
ln(Female literacy)	0.007 (0.18)	0.024 (0.70)	1.109*** (4.63)	0.093** (2.04)	0.061 (1.36)	0.643*** (4.15)	0.127*** (2.80)	0.095** (2.10)	0.170** (1.97)
Female labour force participation rate	-0.013** (-1.99)	-0.003 (-1.46)	-0.015*** (-4.67)	-0.010 (-1.21)	-0.009*** (-2.90)	-0.012*** (-5.47)	-0.013 (-1.59)	-0.009*** (-3.13)	-0.030** (-2.26)
Total fertility rate	0.182*** (4.78)	0.256 *** (10.47)	0.386*** (16.03)	0.259 *** (5.26)	0.306*** (9.40)	0.265*** (22.08)	0.229*** (4.78)	0.289*** (8.99)	0.278*** (3.45)
HIV prevalence rate	0.045*** (6.72)	0.030*** (6.80)	0.061*** (6.21)	0.073*** (10.80)	0.049*** (9.94)	0.072*** (8.18)	0.066*** (9.71)	0.046*** (9.35)	0.081*** (5.22)
Measles immunization rate	0.0004 (0.69)	-0.0001 (-0.21)	-0.007*** (-10.94)	0.0006 (0.86)	0.0003 (0.42)	-0.006*** (-14.22)	0.0004 (0.61)	0.0002 (0.24)	0.002* (1.90)
ln(ethnic fragmentation)	-	0.081 (1.57)	0.185*** (4.51)	-	0.115* (1.95)	0.187*** (5.17)	-	0.123** (2.11)	0.285*** (2.74)
ln(corruption index)	-	-	-	-0.039 (-1.16)	-0.085** (-2.39)	-0.514*** (-9.86)	-0.23** (-2.51)	-0.361*** (-3.48)	-0.933*** (-4.84)
Corruption index* ln(public health expenditure)	-	-	-	-	-	-	-0.044*** (-3.90)	-0.043*** (-3.54)	-0.052** (-2.28)
Corruption index*ln(private health expenditure)	-	-	-	-	-	-	0.048*** (4.15)	0.048*** (3.88)	0.064*** (2.72)
Constant	7.043*** (8.38)	5.084*** (10.16)	2.914*** (7.34)	7.471*** (6.61)	6.036 *** (8.98)	4.775*** (11.78)	8.562*** (7.67)	6.720*** (9.96)	9.132*** (4.82)
Number of Observations	370	370	370	255	255	255	255	255	255

F-Test, (p-value)	62.06 (0.00)	-	-	88.35 (0.00)	-		79.78 (0.00)		-
R-Squared	60.44	59.30	-	79.03	75.96		80.77	78.14	-
Wald Test χ^2, (p-value)	-	539.09 (0.00)	10490.36 (0.00)		642.76	15499.57 (0.00)		712.62 (0.00)	3075.84 (0.00)
Hausman test χ^2, (p-value)	38.93 (0.00)			37.93 (0.00)			37.84 (0.00)		
Sargan Test χ^2, (p-value)			9.696 (0.96)			25.794 (0.14))			42.292 (0.63)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(2) 1.275 (0.20)			AR(2) -0.108 (0.91)			AR(2) 1.452 (0.15)
Number of Instrumental Variables			29			30			59

.

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model.

2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses.

3) Where p= are the probability values.

4) Instruments:

Model 4 (four period lagged ln (under-five mortality rates) (GMM), ln (private health expenditure), total fertility rates, ln (real GDP per capita), female labour participation, measles immunization rates and the ln (ethnic fragmentation): levels, total fertility rates, ln (real income per capita), female labour force participation, measles immunization rate, ln (ethnic fragmentation) and the ln (public health expenditure).

Model 5 (four period lagged ln (under-five mortality rates) (GMM), ln (private health expenditure), total fertility rate, ln (real GDP per capita), female labour force participation, measles immunization rates, ln (ethnic fragmentation) and the ln (corruption index): levels, total fertility rate, ln (real GDP per capita), female labour force participation, measles immunization rates, ln (corruption index) and the ln (public health expenditure)

Model 6 (four period lagged ln (under-five mortality rate) (GMM) and two period lagged interaction of corruption index and ln (public health expenditure), ln (ethnic fragmentation): levels, ln (ethnic fragmentation).

health expenditure by 1% decreases under-five mortality by about 0.24%. The insignificant private health expenditure coefficient may be due to crowding out effect because of the relatively strong effect of public health expenditure in reducing under-five mortality. The public health expenditure results are consistent with those of Novignon, et al. (2012) and Freire and Kajiura (2011). However, the two studies found that private health expenditure had a negative significant effect on under-five mortality rate. It is vital to note that the two studies have applied different models and estimation methods to the one used in this study. Except for female literacy the coefficients of control variables in model 4 are significant and have expected signs.

When the corruption perception index is included (Model 5) the coefficient of public health expenditure is still negative and has significant effect on under-five mortality while private health expenditure is insignificant. In this case an increase in public health spending by 1% leads to a reduction in under-five mortality by about 0.13%. These results imply that when we control for corruption the effect of public health expenditure on under-five mortality is smaller. The coefficient on level of corruption is negative and significant at 1% level. Increasing the CPI by 1% (lower level of corruption) reduced under-five mortality by about 0.51%. The results for effect of corruption on under-five mortality rates are consistent to those of Yaqub, et al. (2012). In contrast, Hu and Mendoza (2013) and Rajkumar and Swaroop (2008) found a positive and insignificant effects of corruption on under-five mortality rates. Gupta, et al. (2000) found that higher corruption levels had a positive effect on under-five mortality. The estimated coefficients of intervening variables have expected signs (except for female literacy) and are significant.

The results above indicate that public health expenditure is more relevant in reducing child mortality in SSA than private health expenditure. This maybe because most childhood health intervention are public funded. Most health services (such as immunizations; ART therapy for HIV

expectant mothers and children infected; vitamin supplements as well as child growth monitoring) for children under-five years are provided free in public health entities in most of SSA countries.

The interaction variables between public and private health expenditure components and the corruption index (Model 6) are significant. The estimate of interaction between corruption index and public health expenditure is negative while that of corruption perception index and private health expenditure is positive. Similarly, Rajkumar and Swaroop (2008) found a negative coefficient for interaction between public health expenditure and corruption perception index. In contrast, both Hu and Mendoza (2013) and Yaqub, et al. (2012) found positive effect of interactions of public health expenditure and corruption index on under-five mortality but the former had insignificant estimates. The control variables estimates in the model exhibit expected signs (except for measles immunization and female literacy) and are significant.

The net effects of public and private health expenditure taking into account their interaction with the corruption perception index are derived and presented in Table 16. The net effect is evaluated at the mean, minimum and maximum levels of corruption. The estimates of public and private health expenditure and the interactive variables are obtained from Table 15.

Table 16: Effectiveness of Public and Private Health Expenditure on Under-Five Mortality Rates in Sub-Saharan Africa Based on Estimates of Linear Dynamic Panel Model

Corruption Perception Index (CPI)	**Mean**	**Min**	**Max**
	3	**1**	**6.4**
A. Effectiveness of Public Health Expenditure			
ln (public health expenditure)	0.174	0.174	0.174
Corruption index*ln (public health expenditure)	-0.156	-0.052	-0.332
Net Effect	**0.018**	**0.122**	**-0.158**
B. Effectiveness of Private Health Expenditure			
ln (private health expenditure)	-0.328	-0.328	-0.328
Corruption index*ln(private health expenditure	0.192	0.064	0.410
Net Effect	**-0.136**	**-0.264**	**0.082**

Calculations based on estimates in Model 6 of Table 15.

The estimates in Table 16 show that in high corruption scenario (CPI = 1) 1% increase in public health expenditure increases under-five mortality rate by 0.12% while private health spending reduced under-five mortality rate by about 0.26%. Increasing public spending on health care by 1% in a country with average level of corruption (CPI = 3) increases under-five mortality by about 0.02%. But raising private health spending by 1% reduces under-five mortality by about 0.14%. In low corruption environment (CPI = 6.4), an increase in public health spending by 1% leads to a fall in under-five mortality by about 0.16%. But increasing private health spending by 1% increased under-five mortality by about 0.08%.

The results indicate that when corruption is perceived to be low (high CPI) the effectiveness of public health spending on under-five mortality increases. In contrast, when corruption is perceived as high (low CPI) private health expenditure effectiveness is high.

4.3 Regional Differences in the Impact of Health Care Spending and Corruption on Under-Five Mortality Rates

Equations (3.10), (3.11) and (3.12) estimations are presented in this section. Regional differences in the effect of health care spending (total, public and/or private) and level of corruption on under-five mortality rates results are presented in sections 4.3.1 and 4.3.2 based on GMM-IV linear dynamic panel estimates. The estimated results are shown in Tables 17, 18, 19 and 20.

4.3.1 Regional Based Total Health Expenditure, Corruption and Under-Five Mortality Rates

The regression results for the relationship between total health expenditure, corruption and under-five mortality are presented in Table 17. The econometric estimates are displayed in three models. To investigate whether the impact of total health expenditure and perceptions about corruption differs across regions within SSA, these variables were interacted with three dummy variables for Eastern Africa, Central Africa and Western Africa. Southern Africa dummy is omitted

Table 17: Regional Differences of Total Health Expenditure and Corruption Influence on Under-Five Mortality (Dependent Variable is ln (Under-Five Mortality Rates))

Independent Variables	Model 7			Model 8			Model 9		
	FE	RE	LDPD	FE	RE	LDPD	FE	RE	LDPD
ln(Total health expenditure)	**-0.181*** (-5.68)**	**-0.08*** (-3.72)**	**-0.356*** (-4.74)**	**-0.101** (-2.52)**	**-0.107*** (-4.30)**	**-0.092*** (-3.12)**	**-0.098** (-2.45)**	**-0.109*** (-4.40)**	**0.075*** (2.62)**
ln(Real Gross Domestic Product per Capita)	**-0.08* (-1.72)**	**-0.166*** (-4.31)**	**-0.268*** (-3.08)**	**-0.590*** (-6.53)**	**-0.254*** (-4.73)**	**-0.578*** (-7.93)**	**-0.583** (-2.45)**	**-0.252*** (-4.70)**	**-0.589*** (-8.25)**
ln(Female literacy)	**0.012 (0.33)**	**0.020 (0.59)**	**0.482* (1.91)**	**0.107** (2.35)**	**0.059 (1.29)**	**-0.091 (-0.75)**	**0.095** (2.09)**	**0.048 (1.05)**	**-0.120 (-1.05)**
Female labour force participation rate	**-0.018*** (-2.85)**	**-0.004* (-1.86)**	**-0.009* (-1.77)**	**-0.021** (-2.32)**	**-0.008*** (-3.20)**	**-0.003 (-0.83)**	**-0.020** (-2.26)**	**-0.008*** (-3.10)**	**-0.003 (-0.66)**
Total fertility rate	**0.140*** (3.75)**	**0.235*** (9.87)**	**0.176*** (2.73)**	**0.147*** (2.90)**	**0.252*** (8.36)**	**-0.062 (-1.48)**	**0.151*** (2.99)**	**0.252*** (8.37)**	**-0.056 (-1.31)**
HIV prevalence rate	**0.037*** (5.51)**	**0.033*** (7.32)**	**0.077*** (10.25)**	**0.067*** (9.34)**	**0.049*** (10.40)**	**0.045*** (7.96)**	**0.067*** (9.26)**	**0.049*** (10.41)**	**0.046*** (8.18)**
Measles immunization rate	**0.0003 (0.43)**	**-0.0001 (-0.16)**	**0.002 (0.94)**	**-0.0004 (-0.64)**	**-0.001 (-1.54)**	**-0.008*** (-3.98)**	**-0.0004 (-0.66)**	**-0.001 (-1.56)**	**-0.007*** (-3.61)**
ln(Ethnic fragmentation)	-	**0.052 (1.02)**	**0.973*** (4.85)**	-	**0.082* (1.65)**	**-0.023 (-0.22)**	-	**0.082 (1.64)**	**-0.021 (-0.20)**
Eastern African Dummy	**-0.160*** (-3.48)**	**-0.121*** (-2.63)**	**-0.202** (-2.32)**	**-0.165*** (-3.04)**	**-0.169*** (-2.91)**	**-0.258 (-1.36)**	**-0.167*** (-3.37)**	**-0.155*** (-2.96)**	**-0.189 (-1.11)**
Central African Dummy	-	**-1.563** (-2.04)**	**-4.390* (-1.94)**	-	**-1.826 (-1.57)**	**4.574* (1.78)**	-	**-1.722 (-1.54)**	**4.995** (2.05)**
Western African Dummy	-	**0.382*** (2.77)**	**0.705* (1.88)**	-	**0.034 (0.20)**	**0.933 (1.37)**	-	**0.0001 (0.00)**	**1.046 (1.37)**
Eastern African Dummy* ln(Total health expenditure)	**0.103*** (3.84)**	**0.077*** (2.91)**	**0.116*** (2.62)**	**0.102*** (3.55)**	**0.064** (2.10)**	**-0.027 (-0.37)**	**0.095*** (3.25)**	**0.054* (1.74)**	**-0.023 (-0.32)**
Western African Dummy* ln(Total health expenditure)	**-0.0001 (-0.00)**	**-0.066 (-1.12)**	**0.281*** (3.91)**	**0.032 (0.44)**	**0.061 (0.81)**	**-0.775*** (-2.91)**	**0.022 (0.30)**	**0.097* (1.77)**	**-0.855*** (-3.13)**
Central African Dummy*	**0.133***	**0.100***	**0.248**	**0.124**	**0.106***	**-0.235***	**0.108***	**0.054**	**-0.264**

ln(Total health expenditure)	(3.28)	(2.65)	(2.17)	(2.01)	(1.88)	(-1.92)	(1.80)	(0.72)	(-2.29)
ln(Corruption index)	-	-	-	**-0.099**** (-1.98)	**-0.172***** (-3.12)	**-0.870***** (-5.75)	**-0.098**** (-2.04)	**-0.174***** (-3.37)	**-0.815***** (-5.59)
Eastern African Dummy* ln(Corruption Index)	-	-	-	**0.008** (0.22)	**0.071*** (1.75)	**0.369**** (2.20)	-	-	-
Western African Dummy* ln(Corruption Index)	-	-	-	**0.192***** (2.79)	**0.199**** (2.56)	**0.756***** (2.87)	-	-	-
Central African Dummy* ln(Corruption Index)	-	-	-	**0.220*** (1.69)	**0.268*** (1.87)	**0.958***** (3.52)	-	-	-
Eastern African Dummy*Corruption Index *ln(Total health expenditure)	-	-	-	-	-	-	**0.0003** (0.67)	**0.001**** (2.30)	**0.005**** (2.28)
Western African Dummy*Corruption Index*ln(Total health expenditure)	-	-	-	-	-	-	**0.004***** (2.74)	**0.004***** (2.72)	**0.014**** (2.42)
Central African Dummy*Corruption Index*ln(Total health expenditure)	-	-	-	-	-	-	**0.005** (1.61)	**0.006*** (1.93)	**0.021***** (3.11)
Constant	**8.720***** (10.62)	**6.058***** (12.02)	**6.522***** (7.59)	**10.453***** (9.01)	**7.161***** (11.66)	**9.051***** (12.89)	**10.377***** (8.93)	**7.238***** (11.80)	**9.346***** (12.76)
Number of Observations	362	362	362	251	251	251	251	251	251
F-Test, (p-value)	51.71 (0.00)	-	-	55.16 (0.00)	-	-	54.97 (0.00)	-	-
R-Squared	64.4	62.8	-	80.5	78.01	-	80.4	78.1	-
Wald Test χ^2, (p-value)	-	611.63 (0.00)	44793.93 (0.00)	-	693.23 (0.00)	11,707.32 (0.00)	-	706.46 (0.00)	12178.27 (0.00)
Hausman test χ^2, (p-value)	36.61 (0.00)		-	93.85 (0.00)		-	47.51 (0.00)		-
Sargan Test χ^2, (p-value)	-	-	23.217 (0.33)	-	-	40.831 (0.27)	-	-	43.616 (0.18)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(3) 1.563			AR(2) -0.347			AR(3) -0.580

			(0.12)			(0.73)			(0.56)
Number of Instrumental Variables			36			55			55

Notes: (1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model.
(2) t-values for FE Estimation, and z-values for RE and LDPD estimations are in parentheses.
(3) Where p= are the probability values.
(4) ***, **, *** represent significance at 1%, 5% and 10% respectively.
(5) Instruments:

Model 7 (three period lagged ln (real GDP per capita) (GMM), Western Africa dummy* ln (total health expenditure), total fertility rates, ln (under-five mortality rate), ln (total health expenditure), measles immunization rates, and HIV prevalence rate: levels, measles immunization rate, HIV prevalence rate and female labour force participation).

Model 8 (two period lagged ln (real GDP per capita) (GMM), HIV prevalence rate, ln (under-five mortality rate), Western Africa dummy* ln (total health expenditure) and Central Africa dummy* ln (total health expenditure): levels, two period lagged differenced ln (total health expenditure) (GMM) and four period lagged difference ln (corruption index) (GMM), ln (under-five mortality rates), Western Africa dummy* ln (total health expenditure), Central Africa dummy*ln (total health expenditure), Western Africa* ln (corruption index) and ln (female literacy)).

Model 9 (two period lagged ln (real GDP per capita) (GMM), HIV prevalence rate, ln (under-five mortality rate), Western Africa dummy*ln (total health expenditure), Central Africa*ln (total health expenditure) and the ln (female literacy): levels, two period lagged differenced ln (total health expenditure) (GMM), four period lagged ln (corruption index) (GMM), ln (under-five mortality rate), Western Africa dummy* ln (total health expenditure), Central Africa dummy* ln (total health expenditure), ln (female literacy), Western Africa dummy* ln (corruption index)).

Table 18: Regional Differences of Total Health Expenditure and Corruption Effects on Under-Five Mortality Rates

Dummy variables for the Region takes the value of 1; 0 otherwise.									
Computation Based on LDPD Estimates									
Model 7a: Regional Variations of Total Health Care Spending									
ln(Total health expenditure)	**Eastern African Dummy* ln(Total health expenditure)**	**Western African Dummy* ln(Total health expenditure)**	**Central African Dummy* ln(Total health expenditure)**				**Eastern Africa**	**Western Africa**	**Central Africa**
-0.356	0.116	0.281	0.248				**-0.240**	**-0.075**	**-0.108**
Model 8a: Regional Variations of Total Health Care Spending and Corruption									
ln(Total health expenditure)	**Eastern African Dummy* ln(Total health expenditure)**	**Western African Dummy* ln(Total health expenditure)**	**Central African Dummy* ln(Total health expenditure)**				**Eastern Africa**	**Western Africa**	**Central Africa**
-0.092	-0.258*	-0.775	-0.235				**-0.350**	**-0.867**	**-0.327**
ln(Corruption Index)	**Eastern African Dummy* ln(Corruption Index)**	**Western African Dummy* ln(Corruption index)**	**Central African Dummy* ln(Corruption Index)**						
-0.870	0.369	0.756	0.958				**-0.501**	**-0.114**	**0.088**
Model 9a: Regional Variations of Total Health Spending Efficacy (Interaction -Regional Dummy* Total Health Expenditure* Corruption); Computed using CPI Values at the mean									
ln(Total health expenditure)	**Eastern African Dummy* ln(Total health expenditure)**	**Western African Dummy* ln(Total health expenditure)**	**Central African Dummy* ln (Total health expenditure)**	**Eastern African Dummy*log(Corruption Index)* ln(Total health expenditure)**	**Western African Dummy*log(Corruption Index)* ln(Total health expenditure)**	**Central African Dummy*log(Corruption Index)* ln(Total health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
0.075	-0.023*	-0.855	-0.264	0.015	0.042	0.063	0.067	-0.738	-0.126

Note: (1) The computation are based on estimates in Table 17 and they correspond to models 7, 8 and 9; (2) Mean values of CPI are extracted from the descriptive statistics; (3) The first column estimates are for Southern Africa. The values with asterisks (*) are insignificant (see Table 17).

to avoid dummy variable trap. The estimation results of under-five mortality equation with interaction terms are reported in Table 17.

The Wald test p-value (0.00) indicates that the null hypothesis of no joint significance is rejected and the three GMM models are well fitted. The p-value for Arellano-Bond test shows that the null hypothesis of no serial correlation in the first difference errors cannot be rejected. The Sargan test cannot reject the null hypothesis of over-identification restrictions being valid as the p-value is large.

The parameter estimates of the variables of interest (health expenditure, corruption perception index and interaction terms) were used to derive the effectiveness of health expenditure on under-five mortality rate for the different SSA sub-regions. Table 18 shows estimates of the effectiveness of total health expenditure. The reference sub-region is Southern Africa.

In the baseline model (model 7a) increasing total health expenditure by 1% reduced under-five mortality in Southern Africa by 0.36%, followed by Eastern Africa (0.24%), Central Africa (0.11%) and Western Africa (0.08%). So, total health expenditure reduces under-five mortality most effectively in Southern Africa.

When effect of corruption level is taken into account (Model 8a) the magnitudes of the effectiveness of total health expenditure across the four regions change. For instance, effectiveness of total health expenditure in Western Africa and Central Africa is greater than the other two regions. On the other hand, effectiveness of Southern Africa and Eastern Africa total health expenditure is reduced when we control for corruption levels. Raising total health expenditure by 1% reduces under-five mortality by 0.87% and 0.33% for Western and Central Africa respectively.

Table 18 also shows that there are regional differences in effectiveness of reduced corruption levels on under-five mortality. In particular, lowering corruption levels in Southern Africa is more

effective in reducing under-five mortality, than the other three regions. When corruption levels are dropped by 1% under-five mortality in Southern Africa is reduced by about 0.87%, 0.5% in Eastern Africa and 0.11% in Western Africa. In contrast in Central Africa, reduced level of corruption increases under-five mortality by 0.09%.

Model 9a was used to investigate how perceived corruption levels affects the effect of total health expenditure on under-five mortality. Western Africa exhibits higher effectiveness of total health expenditure than the other three regions. At average corruption perception index (CPI = 3), increasing total health expenditure by 1% in Western Africa reduced under-five mortality by about 0.74% compared with 0.13% in Central Africa. But 1% increase in total health expenditure raise under-five mortality by 0.08% and 0.07% in Southern Africa and Eastern Africa respectively.

4.3.2 Regional Based Public and Private Health Expenditure, Corruption and Under-Five Mortality Rates

This section presents estimates of the effect of public and private components of health expenditures and perceived corruption levels on under-five mortality rates in SSA sub-regions. The results are presented in Table 19. The estimated equations are similar to those estimated in section 4.3.1 except health expenditure is disaggregated into public and private components. Wald test reject the null of no joint significance of the coefficient estimates because the p-value is 0 in the three GMM models. Arellano-Bond test fails to reject the null of no serial correlation in the models specified as the p-value is large. Additionally, the Sargan test null hypothesis of over-identification restriction are valid cannot be rejected because the estimate of p-value is large. This show that the instruments used in the GMM models are valid.

The econometric results in Table 19 are employed in Table 20 to derive effects of public and private health expenditure and corruption perception on under-five mortality rates in the SSA sub-regions. Table 20 corresponds to the models 10, 11 and 12 in Table 19.

Table 19: Regional Differences in Public and Private Health Expenditure, and Corruption Effects on Under-Five Mortality Rates (Dependent Variable is ln (Under-Five Mortality Rates))

Independent Variables	Model 10			Model 11			Model 12		
	FE	RE	LDPD	FE	RE	LDPD	FE	RE	LDPD
ln (public health expenditure)	**-0.111*** ** (-4.29)	**-0.104*** ** (-4.20)	**0.585*** ** (4.92)	**-0.153*** ** (-5.78)	**-0.190*** ** (-7.26)	**-0.151*** ** (-3.28)	**-0.148*** ** (-5.47)	**-0.187*** ** (-7.33)	**-0.077** ** (-2.40)
ln (Private health expenditure)	**-0.003** (-0.09)	**0.035** (1.27)	**-0.202** ** (-2.23)	**0.115*** ** (3.72)	**0.065** ** (2.52)	**-0.190*** ** (-4.31)	**0.085*** ** (2.82)	**0.063** ** (2.42)	**-0.081** ** (-2.07)
ln (Real Gross Domestic Product per Capita)	**-0.176*** ** (-3.60)	**-0.190*** ** (-4.88)	**-0.076** (-0.89)	**-0.516*** ** (-6.14)	**-0.208*** ** (-3.92)	**-0.066** (-0.85)	**-0.527*** ** (-6.04)	**-0.260*** ** (-4.37)	**-0.213** ** (-1.96)
ln (Female literacy)	**0.020** (0.51)	**0.028** (0.80)	**-0.916*** ** (-4.67)	**0.075** (1.65)	**0.046** (1.00)	**0.149** ** (2.48)	**0.098** ** (2.04)	**0.068** (1.50)	**0.083** (1.04)
Female labour force participation rate	**-0.017** ** (-2.56)	**-0.004*** (-1.80)	**0.018** ** (2.39)	**-0.014** (-1.60)	**-0.006** ** (-2.42)	**-0.021*** ** (-6.98)	**-0.017** ** (-1.96)	**-0.008*** ** (-2.64)	**-0.041*** ** (-3.96)
Total fertility rate	**0.160*** ** (4.19)	**0.230*** ** (9.43)	**0.361*** ** (6.86)	**0.235*** ** (5.04)	**0.283*** ** (9.35)	**0.302*** ** (6.42)	**0.251*** ** (5.32)	**0.277*** ** (8.90)	**0.305*** ** (4.29)
HIV prevalence rate	**0.041*** ** (6.05)	**0.035*** ** (7.51)	**-0.035*** ** (-2.84)	**0.065*** ** (9.70)	**0.051*** ** (9.22)	**0.041*** ** (8.72)	**0.066*** ** (9.71)	**0.054*** ** (10.88)	**0.094*** ** (6.36)
Measles immunization rate	**0.0002** (0.24)	**-0.0003** (-0.41)	**-0.002** (-0.60)	**-0.001*** (-1.77)	**-0.001** (-1.30)	**-0.001** (-0.60)	**-0.001** (-1.11)	**-0.001** (-1.15)	**0.001** (0.71)
ln (ethnic fragmentation)	-	**0.027** (0.51)	**-0.293*** ** (-2.72)	-	**0.076** (1.56)	**0.667*** ** (6.35)	-	**0.073** (1.23)	**1.853** (0.94)
Eastern Africa dummy	**-0.295** (-1.81)	**-0.329** ** (-2.04)	**0.260** (0.46)	**-0.275*** (-1.91)	**-0.367** ** (-2.26)	**-0.507*** (-1.86)	**-0.297*** (-1.94)	**-0.297*** (-1.85)	**0.167** (0.82)
Central Africa dummy	-	**-2.353*** ** (-2.60)	**5.879*** ** (2.79)	-	**-3.374** ** (-2.46)	**-11.260*** ** (-4.79)	-	**-3.112** ** (-2.07)	**-6.108** ** (-2.28)
Western Africa dummy	-	**0.259** (0.35)	**1.987** (0.68)	-	**-1.628*** (-1.97)	**-10.657*** ** (-6.54)	-	**-1.559*** (-1.78)	**-5.452** ** (-2.42)
Eastern Africa dummy* ln (public health expenditure)	**0.044** ** (2.26)	**0.050** ** (2.55)	**0.126** ** (2.05)	**0.043** ** (2.36)	**0.055*** ** (2.65)	**0.061*** (1.91)	**0.049** (1.06)	**0.021** (0.44)	**0.137** ** (2.31)

Western Africa dummy* ln (public health expenditure)	**0.019** (0.51)	**0.031** (0.87)	**-0.725***** (-2.82)	**0.148***** (3.50)	**0.146***** (3.27)	**0.159**** (2.03)	**0.251**** (2.27)	**0.207*** (1.84)	**0.339***** (2.85)
Central African dummy* ln(public health expenditure)	**0.104**** (2.39)	**0.112***** (2.69)	**-0.693***** (-4.75)	**0.197***** (4.35)	**0.215***** (4.38)	**0.109*** (1.71)	**0.356**** (2.07)	**0.331*** (1.87)	**0.115** (0.52)
Eastern Africa dummy* ln (private health expenditure)	**-0.028*** (-1.67)	**-0.032*** (-1.90)	**-0.142***** (-2.98)	**-0.027*** (-1.81)	**-0.037**** (-2.16)	**-0.044*** (-1.69)	**-0.032** (-0.73)	**-0.007** (-0.15)	**-0.147***** (-2.58)
Western Africa dummy* ln (private health expenditure)	**-0.047** (-0.86)	**-0.030** (-0.63)	**-0.532**** (-2.27)	**-0.109*** (-1.74)	**-0.053** (-0.98)	**0.353***** (3.51)	**-0.180** (-1.56)	**-0.119** (-1.06)	**-0.094** (-0.75)
Central African dummy* ln(private health expenditure)	**0.083** (1.19)	**0.035** (0.56)	**0.416**** (2.48)	**0.064** (0.68)	**-0.024** (-0.32)	**0.451***** (3.88)	**-0.111** (-0.51)	**-0.151** (-0.74)	**0.419*** (1.81)
ln (corruption index)	-	-	-	**-0.141***** (-2.95)	**-0.163***** (-3.13)	**-0.252***** (-3.31)	**-0.114**** (-2.41)	**-0.166***** (-3.42)	**-0.067** (-0.79)
Eastern Africa dummy* ln (corruption index)	-	-	-	**-0.021** (-0.58)	**0.026** (0.66)	**-0.153**** (-2.13)	-	-	-
Western Africa dummy* ln (corruption index)	-	-	-	**0.198***** (2.81)	**0.154**** (2.01)	**0.231*** (1.83)	-	-	-
Central African dummy* ln (corruption index)	-	-	-	**0.182** (1.47)	**0.170** (1.26)	**0.299*** (1.84)	-	-	-
Eastern Africa dummy*corruption index* ln (public health expenditure)	-	-	-	-	-	-	**-0.003** (-0.19)	**0.011** (0.65)	**-0.043**** (-2.19)
Western Africa dummy*corruption index* ln (public health expenditure)	-	-	-	-	-	-	**-0.039** (-1.19)	**-0.024** (-0.69)	**-0.083**** (-2.13)
Central African dummy* corruption index* ln(public health expenditure)	-	-	-	-	-	-	**-0.088** (-0.98)	**-0.067** (-0.72)	**-0.026** (-0.23)
Eastern Africa dummy*corruption index* ln (private health expenditure)	-	-	-	-	-	-	**0.003** (0.18)	**-0.010** (-0.62)	**0.043**** (2.22)
Western Africa dummy*corruption index* ln (private health expenditure)	-	-	-	-	-	-	**0.042** (1.20)	**0.027** (0.80)	**0.083**** (2.17)

Central African dummy* corruption index* ln(private health expenditure)	-	-	-	-	-	-	**0.089** (1.02)	**0.070** (0.77)	**0.023** (0.20)
Constant	**7.717***** (9.06)	**5.987***** (11.06)	**0.851** (0.83)	**7.933***** (7.39)	**6.897***** (11.39)	**8.371***** (13.16)	**7.842***** (7.15)	**7.265***** (10.92)	**1.266** (0.19)
Number of Observations	362	362	362	251	251	251	251	251	251
F-Test, (p-value)	35.56 (0.00)	-	-	49.49 (0.00)	-	-	43.04 (0.00)	-	-
R-Squared	62.3	62.3	-	83.5	81.03	-	83.0	81.9	-
Wald Test χ^2, (p-value)	-	605.11 (0.00)	7473.42 (0.00)	-	811.80 (0.00)	36676.92 (0.00)	-	878.07 (0.00)	53454.40 (0.00)
Hausman test χ^2, (p-value)	17.95 (0.265)		-	52.35 (0.00)		-	86.54 (0.00)		-
Sargan Test χ^2, (p-value)	-	-	35.49 (0.27)	-	-	47.836 (0.80)	-	-	60.607 (0.35)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(2) 1.523 (0.13)			AR(3) 0.098 (0.92)			AR(4) 0.651 (0.52)
Number of Instrumental Variables			50	-	-	80	-	-	83

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model.

2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses.

3) Where p= are the probability values.

4) ***, **, * are significance level at 1%, 5% and 10%.

5) Instruments:

Model 10 (two period lagged ln (public health expenditure) (GMM), ln (real GDP per capita) and the Eastern Africa dummy*ln (public health expenditure): levels, one period lagged ln (female literacy) (GMM), ln (real income per capita), Eastern Africa dummy*ln (public health expenditure), ln (private health expenditure), HIV prevalence rate, total fertility rates).

Model 11 (two period lagged ln (private health expenditure) (GMM), the two period lagged ln (real GDP per capita) (GMM), ln (public health expenditure), the ln (female literacy), HIV prevalence rates, total fertility rates, Central Africa dummy*ln (public health expenditure), ln (corruption index), measles immunization rates: levels, the standard instruments are ln (public health expenditure), ln (female literacy), HIV prevalence rates, total fertility rate, Central Africa dummy* ln (public health expenditure), ln (corruption index) and measles immunization rates).

Model 12 (two period lagged ln (private health expenditure) (GMM), four period lagged ln (real GDP per capita) (GMM) , four period lagged ln (corruption index) (GMM), ln (public health expenditure), ln (female literacy), HIV prevalence rates and total fertility rates: level, ln (female literacy), HIV prevalence rates and total fertility rates).

Table 20: Regional Variations of Public and Private Health Expenditure, and Corruption Influences on Under-Five Mortality Rates

Dummy variables for the Region takes the value of 1; 0 otherwise.						
Computation Based on LDPD Estimates						
Model 10a: Regional Variations of Public and Private Health Care Spending						
ln(public health expenditure)	**Eastern African Dummy* ln(public health expenditure)**	**Western African Dummy* ln(public health expenditure)**	**Central African Dummy* ln(public health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
0.585	0.126	-0.725	-0.693	**0.711**	**-0.140**	**-0.108**
ln(private health expenditure)	**Eastern African Dummy* ln(private health expenditure)**	**Western African Dummy* ln(private health expenditure)**	**Central African Dummy* ln(private health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
-0.202	-0.142	-0.532	0.416	**-0.344**	**-0.734**	**0.214**
Model 11a: Regional Variations of Public and Private Health Care Spending and Corruption						
ln(public health expenditure)	**Eastern African Dummy* ln(public health expenditure)**	**Western African Dummy* ln(Total health expenditure)**	**Central African Dummy* ln(public health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
-0.151	0.061	0.159	0.109	**-0.09**	**0.008**	**-0.042**
ln(private health expenditure)	**Eastern African Dummy* ln(private health expenditure)**	**Western African Dummy* ln(private health expenditure)**	**Central African Dummy* ln(private health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
-0.190	-0.044	0.353	0.401	**-0.234**	**0.163**	**0.211**
ln(Corruption Index)	**Eastern African Dummy* ln(Corruption Index)**	**Western African Dummy* ln(Corruption index)**	**Central African Dummy* ln(Corruption Index)**			
-0.257	-0.153	0.231	0.299	**-0.410**	**-0.026**	**0.042**
Model 12a: Regional Variations of Public and Private Health Spending Efficacy (Interaction of Regional Dummy with Public and Private Health Expenditure and Corruption); Computed using CPI Values at the mean=3						

ln(public health expenditure)	Eastern African Dummy* ln(public health expenditure)	Western African Dummy* ln(public health expenditure)	Central African Dummy* ln(public health expenditure)	Eastern African Dummy*ln(Corruption Index)* ln(public health expenditure)	Western African Dummy*ln(Corruption Index)* log(public health expenditure)	Central African Dummy*ln(Corruption Index)* log(public health expenditure)	Eastern Africa	Western Africa	Central Africa
-0.072	0.137	0.339	0.115*	-0.129	-0.249	-0.026*	**-0.064**	**0.018**	**0.017**
ln(private health expenditure)	**Eastern African Dummy* ln(private health expenditure)**	**Western African Dummy* ln(private health expenditure)**	**Central African Dummy* ln(private health expenditure)**	**Eastern African Dummy*ln(Corruption Index)* ln(private health expenditure)**	**Western African Dummy*ln(Corruption Index)* ln(private health expenditure)**	**Central African Dummy*ln(Corruption Index)* ln(private health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
-0.081	-0.147	-0.094	0.419	0.129	0.249	0.023*	**0.099**	**0.074**	**0.361**

Note: 1) Mean values of corruption index are extracted from the descriptive statistics; 3) the values of lnPHE, lnPrivHE and Regional Dummies are incorporated in the computation of regional effectiveness with the corruption index at the mean; 4) the asterisks (*) shows that the values are insignificant (see Table 19).

In Table 20, model 10a examines the baseline regional variations in public and private health spending effects on under-five mortality. The results indicate that Western Africa experiences high effectiveness in both public and private health spending in reducing under-five mortality compared to the other three regions. Increasing Western Africa public and private health spending by 1% reduce under-five mortality by about 0.14% and 0.73% respectively. While increasing public health expenditure reduces under-five mortality by 0.11% in Central Africa and private health expenditure increases it by 0.21%. Southern Africa and Eastern Africa show deteriorating under-five mortality when public health spending is increased. However, when private health expenditure is increased by 1% under-five mortality decreases by 0.34% and 0.20% in both regions respectively.

The results reveal that on the extreme end, Eastern Africa and Southern Africa experience lower effectiveness of public health expenditure than that of their private health expenditure on under-five mortality. The strong effectiveness of private health expenditure substitutes the public health expenditure.

When corruption index is factored in model 11a, effectiveness of public health spending in Southern Africa is higher relative to the other three regions. Increase in public health spending in Southern Africa by 1% reduces under-five mortality by about 0.15%. This is followed by Eastern Africa (0.09%) and Central Africa (0.04%) respectively. Private health spending effectiveness is greater in Eastern Africa relative to that of Southern, Western and Central Africa respectively. Increasing Eastern and Southern Africa private health spending by 1% reduces under-five mortality by about 0.23% and 0.19%. By controlling for corruption in model 11a, the Western Africa public and private health expenditure effects on under-five mortality deteriorates. Eastern Africa and Southern Africa public and private health expenditure turned out to be complementary rather than substitutes as in model 10a. Central Africa maintains the relationship as in model 10a where its

public health expenditure is stronger than private health expenditure in reducing under-five mortality.

Improvement in quality of governance by lowering corruption is vital for efforts to reduce under-five mortality in the SSA sub-regions. Reduced corruption in Eastern Africa is stronger relative to other regions. A reduction in the level of corruption in Eastern Africa by 1% reduces under-five mortality by about 0.41%. This is followed by Southern Africa and Western Africa while effect of corruption on under-five mortality is positive in Central Africa.

In model 12a, increase in public health expenditure at the average corruption perception index (CPI = 3) reduce under-five mortality in Southern and Eastern Africa more than in Western and Central Africa. Considering the average level of corruption in the Southern and Eastern Africa, a rise in public health expenditure by 1% reduces under-five mortality by 0.07% and 0.06% respectively. Southern Africa also has the most effective private health expenditure at the average corruption perception index than the other three regions. Increasing private health expenditure by 1% reduces under-five mortality in Southern Africa by 0.08%.

From the results discussed the effectiveness of public health spending and private health expenditure are still complementary in Southern Africa but substitutable in Eastern Africa. In Western Africa and Central Africa, if both public and private health expenditure are dependent on levels of corruption, the under-five mortality are high in both sectors.

5. Summary, Conclusions and Policy Implications

5.1 Summary

This chapter investigated the effects of health expenditure on child mortality and how governance (measured as corruption perception index) affects the relationship in SSA for the period 2000-2009. Although child mortality in SSA has been declining, under-five mortality are higher than the other

regions of the world. This study argued that policy measures to reduce child mortality in SSA are increasing health expenditure and reducing levels of corruption. Though there have been efforts to increase health expenditure through initiatives such as Abuja Declaration the pace of its implementation is still slow in most of the countries ten years on (Tandon and Cashin, 2010). Meanwhile, the incidence of corruption in all sectors of the economy is still a big challenge and this may have adverse effect on effectiveness of resources allocated to the health sector (Lewis, 2006a; 2006b).

The main objective of this paper is to determine the effects of health expenditure and to assess the impact of governance on effectiveness of health expenditure on under-five mortality in the post Abuja Declaration period.

The study used panel data for 41 countries and employed linear dynamic panel data model. (LDPD). This model is a hybrid of the dynamic panel data methods developed by Arellano and Bond (1991), Arellano and Bouver (1995), and Blundell and Bond (1998). The LDPD is the preferred model because it controls for endogeneity of health expenditure, allows for dynamics, unobserved heterogeneity and embodies stationarity restrictions. The study contributes to a small but potential expanding empirical literature on the role of governance environment plays in the relationship between health expenditure and child mortality. There is dearth of studies focusing on SSA and taking into account dynamics within panel data settings.

The empirical results suggest that total health expenditure reduces under-five mortality in SSA. The results also show that when public health expenditure is stronger in reducing under-five mortality it crowds out the relative effects of private health expenditure. Lowering corruption is essential in achieving low under-five mortality rates.

Further, the results suggest that effectiveness of health expenditure on under-five mortality differs across SSA region. Southern Africa and Eastern Africa total health expenditure is more effective in reduction of under-five mortality than the other three regions. But when effect of corruption is controlled for total health expenditure has greater effectiveness in reducing under-five mortality rates in Western Africa and Central Africa. Southern Africa and Eastern Africa exhibit lower under-five mortality when corruption is reduced relative to other regions. Increasing total health expenditure when corruption levels are average, Western Africa region experienced high reduction in under-five mortality than the other three regions.

The study also found that regional differences in the effect of public and private health expenditure on under-five mortality rate. Public and private health expenditure in Western Africa were more effective in reducing under-five mortality more than the other three regions. When corruption was controlled for, Southern Africa had the strongest public health expenditure while Eastern Africa had the strongest private health expenditure among the four regions. Reducing levels of corruption in both Southern Africa and Eastern Africa reduced under-five mortality rate more than Central and Western Africa. Increasing public and private health expenditure at average levels of corruption reduced under-five mortality in Southern Africa more than the other three regions.

5.2 Conclusion

This study concludes that adequate health expenditure is important for the reduction of under-five mortality rates in Sub-Saharan Africa. Additionally, reducing corruption leads to better child health and high effectiveness in health expenditure geared toward health care. There exist regional differences on the effects of health expenditure and corruption on child health across the four regions; Eastern Africa, Western Africa, Southern Africa and Central Africa. Effectiveness of health expenditure relative to corruption also differs across the regions.

5.3 Policy Implications

This study results have indicated that health expenditure in Sub-Saharan has an improving effect on child health. First, this reveals to policy makers the importance of allocating more resources to health care. Second, it provides a strong argument for commitments in the implementation of Abuja Declaration on public health expenditure targets by Sub-Saharan Africa governments. The issue of health expenditure effectiveness with regard to corruption is important to policy makers. Mitigating against corruption is likely to increase effectiveness of health expenditure, which would improve child health as result of efficient delivery of health service. Because private health expenditure is more effective in high corruption levels, anti-corruption measures may lead public health workers (those who moved their services to private sector) to transfer their services back to public health service. This is because health care seekers are likely to shift demand for health services towards public health sector because of increased effectiveness in service delivery.

Understanding the regional differences in the effectiveness of health expenditure on child health is also relevant to policy makers. Coordinated efforts such as anti-corruption measures, provides a suitable environment for full implementation and assures success of joint health policies in SSA (AU's Abuja Declaration on public health expenditure and the Ouagadougou Framework on primary health). The success of the joint policies between governments and regional affiliations may promote integration and support to countries with weak health outcomes, such as high child mortality.

CHAPTER FOUR

HEALTH EXPENDITURE AND ADULT HEALTH IN SUB-SAHARAN AFRICA

1. Background

Human capital is widely believed to enhance economic growth (Lucas, 1988; Romer, 1990; Mankiw, et al. 1992). This implies that economies are likely to benefit from investment in education, training and health (Hanushek and Kim, 1995; Bloom and Canning, 2000; 2003) as sources of human capital. Africa's human capital base is threatened by major health problems facing adults. These health problems include HIV/AIDS, tuberculosis, malaria and maternal child birth risks (Institute for Health Metrics and Evaluation et al., 2013). The result is premature mortality, loss of human capital and output. In the period 1990-2010, HIV/AIDS led to a rise in healthy years (disability free life) loss by about 328% despite a decline of 22% in the period 2005-2010 (Institute for Health Metrics and Evaluation et al., 2013). The trends in the adult mortality are shown in Table 21.

Table 21: Regional Comparison of Adult Mortality Rates across the World

	Deaths Under-Age of 60 per 1000 alive at age 15		
Region	**1995-2000**	**2000-2005**	**2005-2010**
Sub-Saharan Africa	401	410	383
Northern Africa	187	160	143
South-Central Asia	239	224	210
South-Eastern Asia	214	198	184
Latin America and Caribbean	171	160	148
Europe	164	163	148
North America	116	110	108
Oceania	128	115	107

Source of data: UN DESA (2011).

Adult mortality rates have been declining since 1995 all over the world. Table A.2 in the appendix shows that in 1995-2010 adult mortality rates in most SSA countries declined. However, adult

mortality rates increased in some countries in the period 2000-2005. This may be attributed to HIV/AIDS pandemic which peaked during this period (UNAIDS, 2006). Subsequently with exception of South Africa and Mozambique adult mortality rates declined in 2005-2010.

The decline in adult mortality rates in SSA may be attributed to two factors. First, commitments by SSA governments and development partners increased. This is evidenced by the initiatives for better health during the previous decade and half. The initiatives include Global Fund for HIV/AIDS, Malaria and Tuberculosis (Global Fund, 2013), PEPFAR (PEPFAR, 2013), Abuja Declaration on public health expenditure by AU head of states (OAU, 2001) and the Millenium Development Goals (MDGs). The MDGs on adult health focused on: reduction of maternal mortality by the three-quarters over the period 1990 to 2015; and combating HIV/AIDS, Malaria and, other diseases by 2015 (UN, 2000). Between 1990 and 2008 the maternal mortality rate in SSA decreased by about 230 per 100,000 live births (from 870 in 1990 to 640 in 2008) (United Nations, 2011). Nevertheless, the rate is far below the targeted 218 per 100,000 live births by 2015 (UN, 2000).

HIV/AIDS related deaths declined worldwide by 19% between 2004 and 2009. One of the reasons is that the number of people on anti-retroviral therapy increased 13 times over this period (United Nations, 2011). As HIV/AIDS related deaths fell the number of people living with HIV/AIDS increased since 1990 while, the number of people infected with HIV/AIDS decreased since 2005 (United Nations, 2011).

The second factor that may have contributed to the decline in adult mortality rates in SSA is increased spending on health. Public health spending as a percentage of government expenditure increased from an average of 0.9% in 2000 to 9.8% in 2011 (World Health Organization, 2013). SSA also benefitted from the Global Fund grant of about US$ 2.64 billion towards improving health quality all over the world especially in the developing countries. Through this grant; by 2011

about 3.3 million HIV patients were on antiretroviral (ARV) treatment; about 8.6 million people were on tuberculosis treatment; and more than 230 million insecticide treated nets were distributed to malaria endemic zones (Global Fund, 2011).

Other factors that may have led to reduction in adult mortality rates are; economic growth, increase in literacy and better quality of governance in most parts of the world (Brenner, 2005; Cutler et al., 2006; Lleras-Muney, 2004; Clark and Royer, 2010; Montez et al., 2012).

Despite the decline in adult mortality rates worldwide, Sub-Saharan Africa recorded the highest adult mortality (Table 21). In the period 2005-2010 it averaged 383 per 1000 adults, more than three times that of North America and Oceania. It was more than double, the average adult mortality rates in Northern Africa, Latin America and Caribbean and Europe.

1.1 Problem Statement

Although adult mortality has declined in SSA in the previous decade and half, it is high relative to other regions of the world. In addition, there are large cross-country differences in adult mortality within SSA. Premature mortality is a major challenge for SSA. To stem the attendant loss of human capital, preventable and manageable causes such as HIV/AIDS, malaria and tuberculosis need to be mitigated urgently. SSA countries are under pressure to increase health expenditure aimed at improving adult health.

The average health expenditure per capita in Sub-Saharan Africa was about US$ 155 in 2011 almost seven times lower than the world average (World Bank, 2013). Although efforts to increase public health expenditure in SSA such as the Abuja Declaration of 2001 (OAU, 2001) are yet to be attained (Tandon and Cashin, 2010; World Health Organization, 2011a), it has increased to close to 10% of government revenue.

Although adequate spending on health is important for improving the survival and lowering premature adult mortality, more spending may be ineffective if institutions and governance structures do not operate properly. In particular many SSA countries are characterized by high levels of corruption. The average Transparency International Corruption Perception Index[9] (CPI) for 44 SSA countries was 2.9 out of maximum possible 10 (no corruption) Teorell, et al. (2011).

Despite the high incidence of corruption in SSA, previous studies of the impact of health expenditure on adult health in SSA have rarely investigated the role of corruption in the relationship between health expenditure and adult health. In addition, the econometric methods used in previous studies are subject to bias, which could explain the mixed results in the literature.

1.2 Research Questions

The main research question addressed in this study is: does health expenditure and corruption matter for reduction of adult mortality in Sub-Saharan Africa? The specific research questions addressed in this study are:

1. Does health expenditure affect adult mortality rates in SSA?
2. How does corruption influence the effect of health expenditure on adult mortality in SSA?
3. Does the effect of health expenditure and corruption on adult mortality differ across SSA sub-regions?

1.3 Research Objectives

The main objective of this study is to investigate the relationship between health expenditure and adult health in Sub-Saharan Africa, and the role of corruption levels in that relationship. The specific objectives of this study are:

[9] Transparency International (TI) corruption perception index (CPI score relates to perceptions of the degree of corruption as seen by business people, risk analysts and the general public and ranges between 10 (highly clean) and 0 (highly corrupt).

a) To estimate the impact of health expenditure on adult mortality in SSA.
b) To examine whether level of corruption affects the impact of health spending on adult mortality in SSA.
c) To examine whether there are regional differences in the effect of health care spending and corruption on adult mortality in SSA.

1.4 Contribution of the Study

This chapter extends previous literature in several ways. First, there are only a limited number of studies for SSA analysing the relationship between health spending and adult health. In particular, the study considers adult mortality rate. Adult mortality rate is an indicator of adult health which encompasses the maternal mortality and provides a clear picture of probable human capital loss between the ages of 15-60 years. Intuitively, these are the most active years of individuals and if the society loses them through early death the economic consequences can be enormous. Previous studies of adult health focused on life expectancy (Aisa, et al., 2014; Yaqub, et al., 2012; Novignon, et al., 2012) and maternal mortality rates (Alvarez, et al., 2009). However, variability in life expectancy data is low for annual data and most studies have had to aggregate data over several years (Filmer and Pritchett, 1999). Furthermore life expectancy estimates are derivative of age-specific mortality rates. The life expectancy also indicate probable number of years that individual has to live at birth. Maternal mortality rates are female population specific which does not address adult mortality in its entirety.

Second, few studies in the SSA use dynamic panel models. The study applies linear dynamic panel data model (LDPD) (Arellano and Bond, 1991; Arellano and Bouver, 1995; Blundell and Bond, 1998) to test the relationship between health expenditure, corruption and adult mortality. Linear dynamic panel data model controls for endogeneity, stationarity and unobserved heterogeneity.

Third, existing studies for SSA and other developing regions focused mainly on public health spending. In this study, we examine both public and private health spending. The level of private health expenditure is relatively high in SSA and this study provides evidence on its impact on adult health and compares its effectiveness relative to public health expenditure.

Fourth, only a small number of studies examined the effectiveness of health expenditure in SSA. In particular, this study provides an attempt to assess the direct impact of corruption on adult health and the influence of corruption on the impact of health expenditure on adult health in SSA. Such evidence can provide a firm foundation for anti-corruption measures.

Finally, the study provides evidence on the hypothesis that the effect of health expenditure and corruption on adult health may differ according to SSA sub-regions: Western Africa, Eastern Africa, Central Africa and Southern Africa.

1.5 Organization of the Chapter

The remainder of this paper is organized as follows; section 2 reviews the literature. Section 3 discusses the methodology used in the paper. Section 4 presents the results on health expenditure, corruption and adult mortality in Sub-Saharan Africa. Section 5 presents a summary, conclusion and policy implications.

2. Literature Review

2.1 Adult Health Outcomes

The literature on health expenditure and its relation with adult health takes many forms depending on the health outcome and expenditure category in question. The World Health Organization (2012b) classifies adult health outcomes as; adult mortality rates, life expectancy, adult survival rates and maternal mortality rates. But WHO also classifies adult health outcomes in terms of cause-specific mortality or morbidity.

Although adult mortality rates measure the probability of dying within the age 15-60 years (World Health Organization, 2012b), few studies have analysed the effects of health expenditure and other socio-economic variables on it. Instead most studies have considered life expectancy and maternal mortality rates. Life expectancy is defined at birth in a reference year, or at a specific age. Maternal mortality rate measures the probability of a mother dying per 100,000 live births. The two health indicators are widely considered policy priorities by governments, development partners. For instance, reduction of maternal mortality is one of the MDGs (UN, 2000).

One can argue that adult mortality is the relevant variable to study the consequences of premature mortality in an economy, hence the need for health interventions which can reduce it. Life expectancy may not be suitable, Filmer and Pritchett (1999) argued that life expectancy does not vary much annually and needs to be aggregated over long periods. Second, life expectancy is derived from age-specific mortality rate and in case of data inconsistency it can result into wrong interpretation. Third, maternal mortality rates capture a specific segment of the population and is not likely to capture other mortality occurring in the general population. Auster, et al. (1969) argues that adult mortality as a measure of adult health is objectively derived, has some accuracy which is reasonable, can be accessed readily and is universally accepted. Saikia and Bhat (2008) noted that increased adult mortality leads to a fall in labour force which affects economic growth, biological reproduction and support to younger and older population.

2.2 Health Expenditure and Adult Health

Empirical literature relating to health expenditure, corruption and adult mortality rates is quite rare/little. The studies which have focused on this topic are Auster, et al. (1969) and Or (2000). Adult health outcomes frequently used to measure the effects of health expenditure have included life-expectancy and maternal mortality rates. Recent studies focusing on health expenditure and life expectancy include; Obrizan and Wehby (2012), Yaqub, et al. (2012), Novignon, et al. (2012)

and Aisa, et al. (2014). For health expenditure and maternal mortality rates, studies are such as Alvarez, et al. (2009).

Health Expenditure and Adult Mortality

Auster, et al. (1969) studied the link between medical care proxied by health expenditure per capita and mortality of white adults using a cross-section of all US states in 1960. Using OLS the study found that an increase in health expenditure by 1% reduced age-adjusted death rates by 0.07%. Accounting for endogeneity and simultaneity bias by using 2SLS the results indicated that a 1% increase in health expenditure lowered age-adjusted death rates by 0.12%. Further classification of the age-adjusted deaths by categories such as white collar workers, female not in labour force indicated that an increase in health expenditure by 1% reduced it by 0.1% and 0.9% respectively in the two groups. The study concluded that medical service had a relative importance in reduction of adult mortality in US.

Or (2000) examined the determinants of premature mortality using a panel of 21 OECD countries for the period 1970 to 1992. Premature mortality for both women and men was defined by potential years of life lost. Fixed effect model results showed that increasing total health expenditure per capita by 1% reduced premature mortality in women by 0.18%. Additionally, the study found that raising public health expenditure as a percent of total health expenditure lowered premature mortality in men by 0.18% and women by 0.16%. The paper concluded that increasing health expenditure is crucial in the reduction of premature mortality especially those of women. The study does not account for endogeneity of health expenditure in the premature mortality equations for men and women.

Health Expenditure and Other Adult Health Outcomes

Aìsa, et al (2014) studied the influence of public health expenditure on longevity using a panel of 29 OECD countries from 1960-2000 (5 yearly averaged data) using fixed effect model. The fixed

effects estimates showed that an increase in public health expenditure by 1% increased life expectancy by about 0.13%. The nonlinear fixed effect estimates, showed that increasing public health expenditure by 1% increased life expectancy by 0.21%. The study also examined effect of public and private health expenditure on life expectancy. Raising public health expenditure and its ratio to private health expenditure by 1% increased life expectancy by 0.11% respectively though weakly. The study does not account for endogeneity for total, public and private health expenditure in the longevity equation. This may explain the weak relationships throughout the estimations.

Novignon, et al. (2012) examined the relationship between total, public and private health expenditure and, life expectancy in Sub-Saharan Africa using a panel of 44 countries for the period 1995 to 2010. The fixed effects estimates showed that increasing total public and private health expenditure by 1% increased life expectancy in SSA by 0.44 years. This study does not account for endogeneity of the health expenditure measures with regard to the life expectancy equations.

Craigwell, et al. (2012) investigated the effects of public health expenditure on life expectancy for a panel of 19 Caribbean countries in the period 1995-2007. Using panel OLS, the estimates indicated that an increase in government health expenditure by 1% raised life expectancy by 0.03%. Like Novignon, et al. (2012) the paper did not account for endogeneity of public health expenditure in the life expectancy model.

Obrizan and Wehby (2012) examined the link between health expenditure per capita and life expectancy for males and females using OLS and quantile regression approach for 177 countries. The data used ranged from 2006-2008 for life expectancy, 1997-1999 for health expenditure and control variables 2005-2007. The authors argued that they used 1997-1999 data for health expenditure to reduce simultaneity bias by lagging it for 10 years. This is due to variations in productivity and increased health care spending in some countries, thus allowing time for

realisation of the health expenditure effects. The results showed that health expenditure had positive and significant effects across the life expectancy quantiles. Increasing health expenditure per capita by US$ 100 raised life expectancy of males by 4.13 to 11.5 months while that of the females increase by 5.3 months to 11.9 months. The paper does not account for endogeneity of health expenditure per capita in the life expectancy models. It also cautions that not accounting for unobserved heterogeneity among the countries studied might have led to lower coefficient estimates.

Yaqub, et al. (2012) examined the influence of public health expenditure and governance on life expectancy in Nigeria for the period 1980-2008 using OLS and 2SLS. OLS estimates indicated that increasing public health expenditure by 1% reduced life expectancy by 0.004% but when the interactive term for public health expenditure and corruption index it became positive (0.02%). A 1% decrease in corruption index increased life expectancy by 0.02%. The interaction between corruption index and public health expenditure was negative. Controlling for endogeneity through 2SLS, the estimates showed that public health expenditure reduced life expectancy by 0.02%. Just like OLS, after controlling for corruption the interactive term was positive. The weakness of this study arises from small sample and it did not take into account the time series properties of the data.

Alvarez, et al. (2009) studied factors influencing maternal mortality in Sub-Saharan Africa for the period between 1997 and 2006. The paper used correlation analysis and found that per capita government health expenditure explained reduction of maternal mortality by 45%. The weaknesses of the paper arises from the fact that correlation does not measure causality between health expenditure and maternal mortality rate.

2.3 Summary and Conclusion

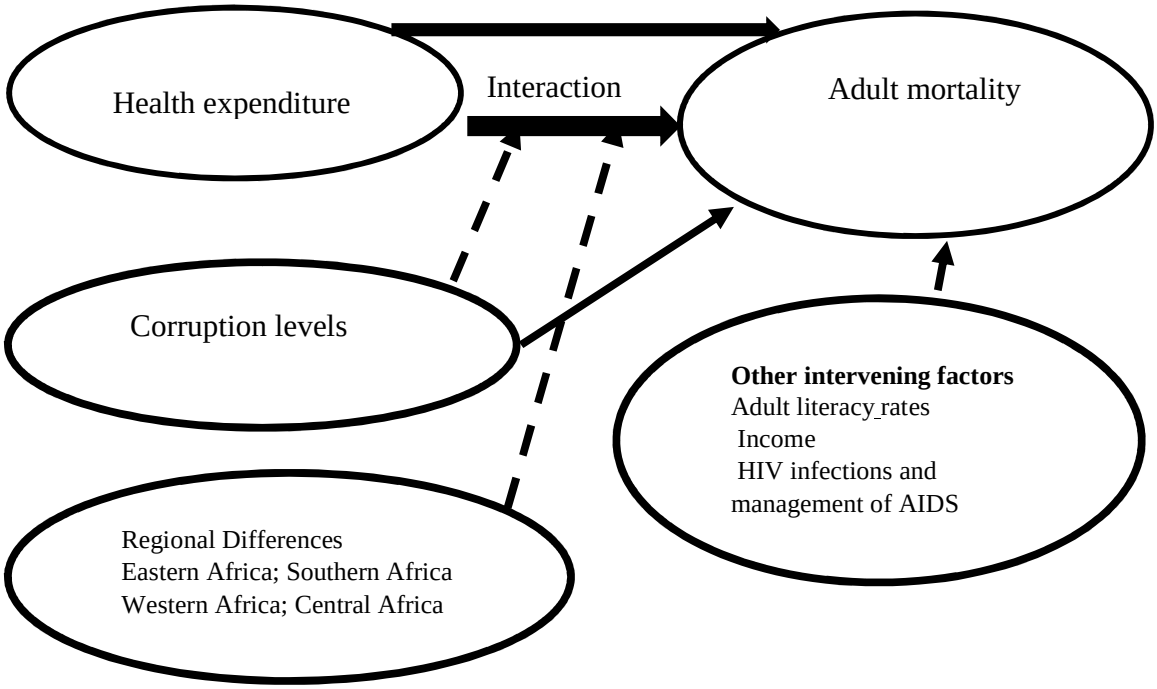
In summary, there is limited literature available on the relationship between health expenditure, corruption and adult mortality. Most of the studies focused on the link between health expenditure and life expectancy or health expenditure and maternal mortality. This study focuses on adult mortality rates. Some studies used OLS and ignored potential endogeneity of health expenditure. Others used 2SLS to control for endogeneity of health expenditure, but ignore unobserved heterogeneity across countries. A few used static panel models (fixed effects and random effects). However, static panel models do not account for endogeneity of health expenditure and dynamics. Consequently, there are conflicting results and methodological problems that should be addressed. This study incorporates a governance variable and used the linear dynamic panel model (GMM-Instrumental Variable) to examine the impact of health expenditure and level of corruption and their interaction on adult mortality. The GMM-IV estimator uses lag-differences and level of variables as instruments to account for endogeneity of health expenditure in the adult mortality equations. This provides robust estimates.

3. Methodology

3.1 Conceptual Model of Health Expenditure, Corruption and Adult Health

A country benefits more from healthy adults through improved human capital. Subsequently, human capital improvement leads to high labour productivity, investment, consumption and economic growth. Therefore investment in activities that can improve adult health through reduction of mortality is important for a country's economic development. The interventions which can reduce adult mortality include adequate health expenditure on health programmes that target adults, increased income per capita, reduced HIV infections and management of AIDS related illnesses and improved adult literacy. The conceptual model is shown diagrammatically in Figure 2.

Figure 2: Conceptual Model for Health Expenditure, Corruption and Adult Mortality



Source: Author (motivated from theoretical models of; Rajkumar and Swaroop (2008), Filmer and Pritchett (1999) and Yaqub, et al., 2012).

Increasing health expenditure targeting adult health interventions, allows accessibility to health care which reduces adult mortality from communicable and noncommunicable diseases. Communicable diseases which affect adults are likely to be HIV/AIDS, lower respiratory infections and maternal related infections while non communicable disease are likely to be diabetes, hypertension, cancer and cardiovascular diseases (Lopez, et al., 2006). Improving transparency and accountability (lowering corruption levels) in resource use, is imperative to reduce adult mortality. This is because quality health care services are likely to be realized when health workers productivity is high, availability of drugs, reduced in-kind payments and no diversion of funds from the system (Lewis, 2006). The role of corruption in enhancing effectiveness of health expenditure cannot be ignored as it imperative for better adult health outcomes such as reduced mortality. Regional differences may also have an influence on effectiveness of health

expenditure in reduction of adult mortality. This is because they have varied health policies and priorities that are likely to influence adult health in different ways. The regions in the conceptual model are Eastern Africa, Western Africa, Southern Africa and Central Africa.

Increased income can improve quality of living through access to good nutrition, housing and working conditions, access to quality health care and education which are likely to prolong life in adults. HIV/AIDS has been one of the fundamental health problem which has increased adult mortality since its discovery in early 1980s. Therefore, reducing new HIV infections and management of AIDS through access to anti-retroviral therapy (ART) is likely to lower adult mortality. Improved adult literacy leads to effective consumption of health information and may increase time preference for adults (Becker and Murphy, 1988). This is likely to lead adults to make lifestyle choices which are likely to improve their health such as good nutrition, and avoidance of risky behaviours (unprotected sex, smoking, and overindulgence on alcohol).

3.2 Theoretical Model

The theoretical model that guides the empirical methodology is based on Rajkumar and Swaroop (2008) and Yaqub, et al. (2012) health production model. The link between health expenditure, corruption and adult mortality is shown in the following health production function.

$$\boldsymbol{M = f\,(RGDPC, HEXP, COR)} \quad \text{.....(4.1)}$$

M is adult mortality rate. $RGDPC$ is real GDP per capita (real income per capita), COR is level of corruption. From Equation 4.1 the model assumes that; increase in real income per capita leads to a reduction in adult mortality. This is through, allocation of resources to interventions in the health sector that focus on adult health and improved welfare of individual in terms of access to good nutrition, living condition and quality health care. Health expenditure affect adult health through provision of health interventions such as contraceptives, ante-natal care and skilled child delivery

services, anti-retroviral therapy, screening and prevention of non-communicable diseases. Access to this health services may improve quality of life through lowering both morbidity and mortality among adults. Lowering corruption in the health sector may result in resource efficiency which is likely to result in effective use of health resources, hence better adult health.

Model (4.1) is transformed in a Cobb-Douglas health production model (4.2). The relationship between health expenditure, real income per capita, corruption and adult mortality (adult health) is expressed as follows.

$$\boldsymbol{M_{it} = A(RGDPC_{it})^{\xi} * (HEXP_{it})^{\psi} * (COR_{it})^{\lambda}} \quad \text{.....(4.2)}$$

In this study M_{it} is defined as adult mortality rates. $RGDPC_{it}$ is real income per capita; and $HEXP_{it}$ represents health spending (total, public and/or private health care spending). COR_{it} is level of corruption. A measures changes in technology which is assumed to be constant. Taking the logarithms of equation (4.2) transforms into linear equation which is written as follows.

$$\boldsymbol{ln\, M_{it} = lnA + \xi\, ln\, RGDPC_{it} + \psi\, ln\, HEXP_{it} + \lambda\, ln\, COR_{it}} \quad \text{.....(4.3)}$$

The parameters can be defined as follows: ξ is the coefficient of real income per capita measuring the elasticity of adult mortality with respect to change in real income per capita. ψ is the coefficient of health spending measuring the elasticity of adult mortality with respect to change in health expenditure. λ is the coefficient of corruption measuring the change in adult mortality with respect to change in governance (through reduced corruption).

Assuming that some part of health spending (total, public and private) is lost or wasted due to corruption, this has consequences on the effectiveness of health spending. Following Yaqub, et al. (2012) and Pritchett (1996), let $\varpi(.)$ denote the part of resources allocated to health that is spent on productive purposes. The ϕ coefficient of health spending on, say programme p takes the form;

$$\boldsymbol{\phi = \delta(.) * \phi_p} \quad \text{.....(4.4)}$$

Where ϕ_p represents the productivity of public or private capital that is created from spending on health programme p. Assume that $\delta(.)$ measures the effectiveness of health spending it can be expressed as a function of state corruption $\boldsymbol{COR_{it}}$. Then,

$$\boldsymbol{\delta = \varpi_0 + \varpi_1 C_{it}} \text{.....(4.5)}$$

Substituting equations (4.4) and (4.5) into (4.3) results into the following equation;

$$\boldsymbol{ln\, M_{it} = lnA + \xi\, ln\, RGDPC_{it} + \phi_p(\varpi_0 + \varpi_1 COR_{it})\, ln\, HEXP_{it} * + \lambda\, ln\, COR_{it}} \text{.....(4.6)}$$

3.3 Empirical Models

To estimate the impact of health expenditure and corruption on adult mortality rate as well as how level of corruption has influenced effectiveness of health expenditure three models are specified. The baseline model measures the effect of health expenditure on adult mortality and is specified with control variables. The model is written as follows.

$$\boldsymbol{lnM_{it} = \varrho_0 + \varrho_1 lnHEXP_{it} + X'_{it}\Gamma + \varepsilon_{it}} \text{.....4.7}$$

To estimate the impact of corruption on adult mortality rates, model (4.7) is extended by adding the corruption index.

$$\boldsymbol{lnM_{it} = \zeta_0 + \zeta_1 lnHEXP_{it} + \zeta_2 lnCOR_{it} + X'_{it}\Gamma + v_{it}} \text{.....4.8}$$

Interaction of corruption index and health expenditure is added to model (4.8) to measure how corruption influences effectiveness of health expenditure on adult mortality rates.

$$\boldsymbol{lnM_{it} = \eta_0 + \eta_1 lnHEXP_{it} + \eta_2 lnCOR_{it} + \eta_3[COR_{it} * lnHEXP_{it}] + X'_{it}\Gamma + \mu_{it}} \text{.....4.9}$$

Equations (4.7), (4.8) and (4.9) relate natural log of adult mortality rates to natural log of health expenditure, natural log of corruption index and interaction of corruption index and natural log of health expenditure.

$ln\,M_{it}$ is the natural log of adult mortality rates; $HEXP_{it}$ is natural log of health expenditure (total, public and/or private); COR_{it} is the natural log of corruption index; $COR_{it} * lnHEXP_{it}$ is the interaction of corruption index and the natural log of health expenditure. The interaction term is used to determine how level of corruption affects the impact of health expenditure on adult mortality. X_{it} is a vector of control variables. The control variables are natural log of real income per capita, natural log of adult literacy rates, HIV prevalence rates and natural log of ethnic fragmentation. Where ε_{it}, v_{it} and μ_{it} are composite error terms. They consists of individual-specific effects and time-specific effects. The composite error terms are assumed to be normally distributed and homoscedastic. ϱ_1, ζ_1 and η_1 are the coefficients of health expenditure and are expected to be negative. ζ_2 and η_2 are the coefficients of the corruption and are expected to be negative. η_3 is the coefficient of the interaction of corruption index and health expenditure and the signs can be either positive and negative. Γ-is the vector of coefficients of the control variables.

The regional differences in the impact of health expenditure and corruption on adult mortality rates is estimated through three models. The three models are characterised by adding regional dummy variables and interacting them with health expenditure and corruption.

The first model for regional differences on effect of health expenditure on adult mortality rates is written as follows.

$$\boldsymbol{lnM_{it} = \varrho_0 + \varrho_1 lnHEXP_{it} + \varrho_2 EA_i + \varrho_3 CA_i + \varrho_4 WA_i + \varrho_5[EA_i * lnHEXP_{it}] + \varrho_6[CA_i * lnHEXP_{it}] + \varrho_7[WA_i * lnHEXP_{it}] + X'_{it}\Gamma + \omega_{it}} \quad \text{.....(4.10)}$$

The second model is an extension of model (4.10) capturing the regional differences on effect of corruption on adult mortality rate.

$$\boldsymbol{lnM_{it} = \zeta_0 + \zeta_1 lnHEXP_{it} + \zeta_2 EA_i + \zeta_3 CA_i + \zeta_4 WA_i + \zeta_5[EA_i * lnHEXP_{it}] + \zeta_6[CA_i * lnHEX_{it}] + \zeta_7[WA_i * lnHEX_{it}] + \zeta_8 lnCOR_{it} + \zeta_9[EA_i * lnCOR_{it}] + \zeta_{10}[CA_i * lnCOR_{it}] + \zeta_{11}[WA_i * lnCOR_{it}] + X'_{it}\Gamma + \kappa_{it}} \quad \text{(4.11)}$$

The third model extends model (4.11) by adding the interaction of corruption and health expenditure at the regional level. It measures how corruption influences health expenditure effectiveness on adult mortality rates in SSA sub regions.

$$\boldsymbol{lnM_{it} = \eta_0 + \eta_1 lnHEXP_{it} + \eta_2 EA_i + \eta_3 CA_i + \eta_4 WA_i + \eta_5[EA_i * lnHEXP_{it}] + \eta_6[CA_i * lnHEXP_{it}] + \eta_7[WA_i * lnHEXP_{it}] + \eta_8 lnCOR_{it} + \eta_9[EA_i * COR_{it} * lnHEXP_{it}] + \eta_{10}[CA_i * COR_{it} * lnHEXP_{it}] + \eta_{11}[WA_i * COR_{it} * lnHEXP_{it}] + X'_{it}\Gamma + \lambda_{it}} \quad \text{(4.12)}$$

Equations (4.10), (4.11) and (4.12) relates natural log of adult mortality with natural log of health expenditure, regional dummy variables Eastern Africa (EA), Central Africa (CA) and Western Africa (WA), interaction of regional dummy variables with natural log of health expenditure, natural log of corruption index, interaction of regional dummy variables with natural log of corruption index, interaction of regional dummy variables with corruption index and natural log of health expenditure. The control variables are as defined in earlier equations. Where ω_{it}, κ_{it} and λ_{it} are composite error terms.

3.4 Variables Definition and Data Sources

This section describes the data used in the adult health regressions. Table 22, presents the variables names (Column 1), a short description of the variable (column 2) and the source of data for each variable (column 3).

Table 22: Data Sources and Definition of Variables

Variable Name	Variable Description	Data Source
Adult Mortality Rates	Adult mortality rate is the probability of dying between the ages of 15 and 60 that is the probability of a 15-year-old dying before reaching age 60, if subject to current age-specific mortality rates between those ages.	World Development Indicators (World Bank,2011)
Public Health Expenditure	Public health expenditure consists of recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds. Measured as the total public health expenditure.	World Development Indicators (World Bank,2011); WHO National Health Accounts, 2013
Private Health Expenditure	Private health expenditure includes direct household (out-of-pocket) spending, private insurance, charitable donations, and direct service payments by private corporations. Measured as total private health expenditure.	World Development Indicators (World Bank,2011) ;WHO National Health Accounts, 2013
Total Health Expenditure	Total health expenditure is the sum of public and private health expenditures. It covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health but does not include provision of water and sanitation. Measured as the total health expenditure.	World Development Indicators (World Bank,2011); WHO National Health Accounts, 2013
Real Income per Capita	GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. Data are in constant 2005 US$.	World Development Indicators (World Bank, 2011)
HIV Prevalence Rate	Prevalence of HIV refers to the percentage of people ages 15-49 that are infected with HIV.	World Development Indicators (World Bank, 2011)
Ethnic Fragmentation	Reflects probability that two randomly selected people from a given country will not belong to the same ethnolinguistic group. The higher the number, the more fractionalized society. The definition of ethnicity involves a combination of racial and linguistic characteristics. It's a proxy for social capital.	University of Gothenburg (Quality of Governance Institute).

Transparency International-Corruption Perception Index	The CPI focuses on corruption in the public sector and defines corruption as the abuse of public office for private gain. The surveys used in compiling the CPI tend to ask questions in line with the misuse of public power for private benefit, with a focus, for example, on bribe-taking by public officials in public procurement. The sources do not distinguish between administrative and political corruption. The CPI Score relates to perceptions of the degree of corruption as seen by business people, risk analysts and the general public and ranges between 10 (highly clean) and 0 (highly corrupt).	University of Gothenburg (Quality of Governance Institute)(2011)
Adult Literacy	Total gross enrolment ratio is the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. This is a basic measure for literacy as ability to read, write and speak. A proxy for adult literacy.	World Development Indicators (World Bank, 2011)

3.5 Estimation

The econometric models specified in section 3.3 were estimated using panel static panel and dynamic panel data models. The static panel data methods used in the study are fixed effect (FE) and random effect (RE) models. The weakness of the models is that they are based on country specific effects and they do not account for stationarity and endogeneity. Health expenditure could be endogenous in mortality equations if there are omitted variables and reverse causality. For instance, economic shocks, population changes and political shocks are likely to be omitted variables correlated with health expenditure. Reverse causality may arise when increase in adult mortality triggers SSA governments and households to increase health expenditure. On the other hand, increase in health expenditure may lead to lower adult mortality rates. There are also problems of unobserved heterogeneity and lagged dependent variable in dynamic models. Estimation under these problems can produce inconsistent and biased estimates. To account for these weaknesses linear dynamic panel model (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998) which is based on the principles of GMM-IV was used as the key estimation technique. The merits of linear dynamic panel is the assumption of strict

exogeneity and stationarity restrictions and its ability to derive robust results when dynamic instruments are used. The instruments are specified at lag differences, differences and levels.

4. Empirical Results

4.1 Descriptive Statistics

This section presents the descriptive statistics for all variables used in the study. From Table 23, the mean adult mortality rate was 364.8 per 1000 adults across 41 SSA countries. The countries with the highest adult mortality within the period had 616 per 1000 adults, compared with the lowest of 116.9 per 1000 adults. These disparities provides an uneven challenge in joint policies in the SSA to reduce premature mortality.

Table 23: Descriptive Statistics of Variables Included in the Adult Mortality Equation

Variable	Obs	Mean	Std. Dev	Min	Max
Adult Mortality Rates (AMR) per 1000 adults)	402	364.8	108.5	116.9	616.3
Public Health Expenditure (Million US$ Constant 2000)	410	759	2,160	4.98	15,700
Private Health Expenditure (Million Constant 2000 US$)	410	1,130	3,490	7.4	23,500
Total Health Expenditure (Million US $ 2005 Constant)	410	1890	5,620	14.1	39,200
Real GDP per Capita (2005, PPP International US$)	409	3259.4	4998.2	346.1	31738.2
HIV Prevalence Rate (%)	370	6.2	7.1	0.1	26.3
Ethnic Fragmentation	410	0.63	0.23	0.01	0.93
Transparency International-Corruption Perception Index (TICPI)	276	3.02	1.06	1	6.4
Adult Literacy	410	96.6	25.2	32.2	154.2

The average public health spending was about US$ 759 Million (2000, constant) while the average private health care spending was 1.4 times higher than the public expenditure. Total health spending averaged at US$ 1,890 million. The total health spending had a ratio of public and private health expenditure at 1:1.5. This indicates that the burden of health expenditure is leaning more towards the households rather than the government.

The mean Corruption Perception Index of 3.02 out of a possible 10, shows that corruption levels are perceived to be high in SSA. This is likely to affect resource allocation and its effectiveness in various sectors including the health sector. Thus, health expenditure may be ineffective on reducing adult mortality when corruption levels are high. The variability in real GDP per capita in SSA is quite high as the standard deviation show. The average HIV prevalence rate was about 6.2% but in one country it was 26.3%. Average adult literacy measured as primary school gross enrolment ratio was 96.6. However, one of the country had very low literacy rates of 32.2 for adults. The average ethnic fragmentation (a proxy for social cohesion) was 0.63. This indicates the ethnic diversity in SSA which might result in frequent social and political conflicts in public resource allocation thus affecting health care.

4.2 Econometric Estimates for Health Care Spending, Corruption and Adult Mortality in SSA

This section presents the regression results for the effects of total health care spending, public and private health care spending and level of corruption on adult mortality rates in SSA. The estimation methods applied are: fixed effects (FE), random effects (RE) and linear dynamic panel data (LDPD). Econometric results are interpreted based on the linear dynamic panel data estimates.

4.2.1 Total Health Expenditure, Corruption and Adult Mortality Rates

The estimation results of the impact of total health expenditure and level of corruption on adult mortality rates are reported in Tables 24 and 25 respectively. The results are shown in three models. In Model 1 (baseline specification) relationship between total health expenditure and adult mortality rates are shown in column 1, 2 and 3. The results when corruption is added to the baseline specification are reported under model 2 (columns 3, 4 and 5). In model 3 interaction of total health expenditure and corruption index is added to determine effectiveness of total health expenditure on adult mortality rates.

Table 24: Effects of Total Health Expenditure and Corruption on Adult Mortality Rates (Dependent Variable is ln (Adult Mortality Rates)

Independent Variables	Model 1			Model 2			Model 3		
	FE	RE	LDPD	FE	RE	LDPD	FE	RE	LDPD
ln(Total health expenditure)	**-0.069*** (-5.36)	**-0.042*** (-3.97)	**-0.064** (-2.02)	**-0.035** (-2.19)	**-0.036*** (-3.35)	**-0.055*** (-2.72)	**-0.032* (-1.95)**	**-0.034*** (-3.12)**	**-0.052* (-1.89)**
ln (Real Gross Domestic Product per Capita)	**0.021** (0.86)	**-0.033* (-1.72)**	**-0.059*** (-10.02)**	**-0.142*** (-3.11)**	**-0.106*** (-4.75)**	**-0.031*** (-2.80)**	**-0.146*** (-3.18)**	**-0.106*** (-4.70)**	**-0.020* (-1.69)**
Log (Adult literacy)	**-0.118*** (-6.04)**	**-0.128*** (-6.67)**	**-0.413*** (-3.54)**	**-0.076 *** (-3.08)**	**-0.084*** (-3.48)**	**-0.355*** (-2.69)**	**-0.073*** (-2.94)**	**-0.083*** (-3.40)**	**-0.058*** (-3.75)**
HIV prevalence rate	**0.032*** (9.51)**	**0.035*** (13.60)**	**0.042*** (63.58)**	**0.047*** (12.21)**	**0.044*** (17.63)**	**0.037*** (5.58)**	**0.047*** (12.16)**	**0.044*** (17.33)**	**0.051*** (43.87)**
ln (ethnic fragmentation)	-	**0.067* (1.95)**	**0.075** (2.36)**	-	**0.081** (2.86)**	**0.095*** (3.34)**	-	**0.820*** (2.85)**	**0.159*** (8.02)**
ln (corruption index)	-	-	-	**-0.048*** (-2.60)**	**-0.067*** (-3.70)**	**-0.256*** (-4.64)**	**-0.011 (-0.20)**	**-0.034 (-0.61)**	**0.234 (0.90)**
Corruption index* ln(total health expenditure)	-	-	-	-	-	-	**-0.001 (-0.70)**	**-0.001 (-0.63)**	**-0.010** (-2.32)**
Const.	**7.468*** (48.05)**	**7.084*** (37.42)**	**8.921*** (39.07)**	**7.755*** (36.62)**	**7.247*** (36.06)**	**8.495*** (21.34)**	**7.721*** (35.47)**	**7.210*** (33.95)**	**6.743*** (13.82)**
Number of Observations	370	370	370	255	255	255	255	255	255
F-Test, (p-value)	82.98 (0.00)	-	-	75.34 (0.00)	-	-	62.72 (0.00)	-	-
R-Squared	43.14	61.22	-	66.85	72.02	-	66.91	72.12	-
Wald Test χ^2, (p-value)	-	379.39 (0.00)	43806.48 (0.00)	-	458.44 (0.00)	433.76 (0.00)	-	456.84 (0.00)	20054.89 (0.00)
Hausman test χ^2, (p-value)	1.11 (0.89)		-	14.59 (0.00)		-	34.86 (0.00)		-
Sargan Test χ^2, (p-value)	-	-	14.009 (0.37)	-	-	22.436 (0.32)	-	-	23.778 (0.21)

Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(2) 1.574 (0.12)			AR(2) 0.754 (0.45)			AR(2) -0.131 (0.90)
Number of Instrumental Variables			19			27			27

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model.
2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses;
3) Where p= are the probability values.
4) ***, **,*- shows significance levels at 1%, 5% and 10%.
5) Instruments:

Model 1 (four period lagged ln (adult literacy) (GMM), differences of HIV prevalence rate and the ln (real GDP per capita): levels, HIV prevalence rates, ln (real income per capita) and ln (ethnic fragmentation).

Model 2 (four period lagged ln (adult literacy) (GMM), HIV prevalence rate, ln (total health expenditure), ln (ethnic fragmentation), ln (real GDP per capita) and ln (corruption index) are differenced instruments).

Model 3 (four period lagged ln (total health expenditure) (GMM), Differences of HIV prevalence rates, ln (real GDP per capita), ln (ethnic fragmentation), ln (corruption index), ln (adult literacy): levels, HIV prevalence rates, ln (real income per capita), ln (ethnic fragmentation), ln (corruption index) and ln (adult literacy)).

Sargan test shows that null of over-identification restriction are valid and cannot be rejected. Thus, indicating that instruments specified in the models are valid. The Wald test rejects the null hypothesis of no joint significance as the p-value is zero. The Arellano-Bond test confirms that there is no serial correlation as the estimates are insignificant.

From Table 24, the point estimate of total health spending in model 1 is negative and significant at 1% level. It indicates that 1% increase in total health spending would reduce adult mortality by about 0.06% annually in SSA. A study for SSA based on static panel models found that increased health spending raised life expectancy (Novignon, et al., 2012). Previous studies outside SSA found that increasing health expenditure per capita would reduce adjusted mortality rates in adults (Auster, et al., 1969) and that increasing total health expenditure reduced premature mortality in women (Or, 2000).

When the model takes into account level of corruption to capture the direct impact of quality of governance on adult mortality (model 2), the point estimate for total health spending is still negative and has significant relationship with adult mortality and its magnitude is unchanged from model 1. The point estimate of corruption index is negative and significant. It indicates that increasing the corruption index (reducing corruption) by 1% decreases adult mortality by about 0.26%. Yaqub, et al. (2012) found that reduced corruption increased life expectancy in Nigeria.

In model 3, the analysis takes into account interaction of total health expenditure and corruption index. This is to determine how corruption influences the relationship between the effectiveness of total health expenditure and adult mortality. The coefficient of total health expenditure is negative and significant while that of the interaction (total health expenditure and corruption index) is positive and significant. Table 25, shows the estimated effect of total health expenditure on adult mortality evaluated at various levels of the corruption index.

Table 25: Effectiveness of Total Health Expenditure on Adult Mortality Rates Based on Estimates of Linear Dynamic Panel Model

Corruption Perception Index.	**Mean**	**Min**	**Max**
	3	**1**	**6.4**
ln (total health expenditure)	-0.052	-0.052	-0.052
Corruption index* ln (total health expenditure)	-0.030	-0.010	-0.064
Net value	**-0.082**	**-0.062**	**-0.116**

Calculations based on regression results on Model 3 of Table 24

The estimates in Table 25 show that when the level of corruption in SSA is high (e.g. CPI=1) 1% increase in total health expenditure reduces adult mortality by about 0.06%. On the other hand, when the level of corruption is low (e.g. CPI=6.4) increasing total health spending by 1% would reduce adult mortality by about 0.12%. The results support the hypothesis that total health expenditure is more effective in SSA when corruption levels are low.

4.2.2 Public and Private Health Expenditure, Corruption and Adult Mortality Rates

In this section effects of public and private health expenditure and corruption on adult mortality results are presented in Tables 26 and 27. In Table 26 three models are specified. A baseline model relating public and private health expenditure to adult mortality rates is shown in Model 4. Model 5 augments model 4 by adding corruption index to determine its effects on adult mortality rates. Model 6 extends model 5 by including the interaction terms (public health expenditure and corruption index, and private health and corruption index) to measure the influence of levels of corruption on effect of public and private health expenditure on adult mortality.

Arellano-Bond test for autocorrelation cannot reject the null of no serial correlation as its p-value is larger than 0.10. The p-value of Wald test is zero, indicating that the null hypothesis of joint significance of the coefficient estimates can be rejected. Sargan test fails to reject the null of over identification restriction being valid because the p-value is large. Thus, the instruments used are valid.

Table 26: Effects of Public and Private Health Expenditure, Corruption on Adult Mortality Rates (Dependent Variable is ln (Adult Mortality Rates))

Independent Variables	Model 4			Model 5			Model 6		
	FE	RE	LDPD	FE	RE	LDPD	FE	RE	LDPD
ln (public health expenditure)	**-0.023**** (-2.33)	**-0.014** (-1.51)	**0.045***** (3.51)	**-0.003** (-0.30)	**-0.008** (-0.84)	**0.016** (0.93)	**-0.050**** (-2.32)	**-0.050**** (-2.38)	**-0.295***** (-4.89)
ln (private health expenditure)	**-0.054***** (-4.46)	**-0.030***** (-2.78)	**-0.084**** (-2.23)	**-0.044***** (-3.49)	**-0.033***** (-3.12)	**-0.108***** (-3.77)	**0.011** (0.45)	**0.014** (0.63)	**0.269***** (4.51)
ln (Real Gross Domestic per Capita)	**0.019** (0.76)	**-0.037 *** (-1.93)	**-0.033**** (-2.24)	**-0.131***** (-2.92)	**-0.108***** (-4.81)	**0.038*** (1.82)	**-0.124***** (-2.77)	**-0.105***** (-4.63)	**-0.083***** (-8.72)
ln (adult literacy)	**-0.116***** (-5.76)	**-0.128***** (-6.51)	**-0.535***** (-5.52)	**-0.080***** (-3.22)	**-0.086***** (-3.49)	**-0.481***** (-3.04)	**-0.096***** (-3.73)	**-0.099***** (-3.89)	**-0.100***** (-7.55)
HIV prevalence rate	**0.032***** (9.54)	**0.036***** (13.73)	**0.032***** (7.31)	**0.047***** (12.55)	**0.044***** (17.65)	**0.035***** (8.28)	**0.050***** (12.90)	**0.045***** (17.59)	**0.054***** (43.64)
ln (ethnic fragmentation)	-	0**.069**** (2.04)	**0.303**** (2.47)	-	**0.087***** (2.99)	**0.650***** (3.87)	-	**0.085***** (2.88)	**0.077***** (14.45)
ln (corruption index)	-	-	-	**-0.047***** (-2.61)	**-0.065***** (-3.59)	**-0.179***** (-5.92)	**0.010** (0.19)	**-0.007** (-0.13)	**-0.354*** (-1.70)
Corruption index* ln (public health expenditure)	-	-	-	-	-	-	**0.016**** (2.49)	**0.014**** (2.22)	**0.065***** (3.13)
Corruption index* ln (private health expenditure)	-	-	-	-	-	-	**-0.017***** (-2.60)	**-0.015 **** (-2.32)	**-0.064**** (-2.06)
Constant	**7.573***** (45.03)	**7.109***** (36.98)	**7.918***** (26.82)	**7.921***** (36.37)	**7.310***** (35.61)	**6.903***** (11.52)	**7.750***** (34.13)	**7.237***** (33.48)	**7.131***** (21.50)
Number of Observations	370	370	370	255	255	255	255	255	255
F-Test, (p-value)	66.90 (0.00)	-	-	65.82 (0.00)	-	-	51.41 (0.00)	-	-
R-Squared	50.49	49.51	-	64.86	64.39	-	65.98	65.58	-
Wald Test χ^2, (p-value)	-	379.08 (0.00)	1817 (0.00)	-	462.08 (0.00)	2739.70 (0.00)	-	473.54 (0.00)	19277.61 (0.00)
Hausman test χ^2, (p-value)	247.35 (0.00)		-	183.24 (0.00)		-	125.68 (0.00)		-

Sargan Test χ^2 (k), (p-value)	-	-	22.33 (0.17)	-	-	26.000 (0.21)	-	-	26.290 (0.45)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(4) -0.369 (0.71)			AR(2) 0.869 (0.39)			AR(3) -0.765 (0.44)
Number of Instrumental Variables			24	-	-	29	-	-	36

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model.

2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses.

3) Where p= are the probability values.

4) ***, **, * are significance levels at 1%, 5% and 10%.

5) Instruments:

Model 4 (four period lagged ln (adult mortality rate) (GMM), differences of HIV prevalence rates, ln (public health expenditure), ln (private health expenditure) and ln (real income per capita): levels, ln (private health expenditure) and ln (real income per capita))

Model 5 (three period lagged ln (adult mortality rates) (GMM), HIV prevalence rates, ln (public health expenditure), ln (private health expenditure) and the ln (real income per capita): levels, ln (public health expenditure), ln (private health expenditure), ln (real income per capita) and ln (corruption index)).

Model 6 (three period lagged ln (public health expenditure) (GMM), HIV prevalence rates, ln (private health expenditure), ln (real income per capita), ln (corruption index) and ln (ethnic fragmentation) are differenced instruments: levels, ln (private health expenditure), ln (real income per capita), ln (corruption index), ln (ethnic fragmentation), ln (adult mortality rates) and ln (adult literacy)).

In model 4 (the baseline model) the coefficient estimate of public health expenditure is positive while that of private health expenditure is negative. Both of them are significantly related to adult mortality. A rise in public health expenditure by 1% increases adult mortality by 0.05%, but increasing private health expenditure lowers adult mortality by 0.08%. From the results, private health expenditure is relatively more effective in reduction of adult mortality than public health expenditure.

When perceived level of corruption is factored in model 5 the public health expenditure coefficient is positive but insignificant. This result is in contrast to that of Or (2000). Or (2000) found that increasing public health expenditure reduced premature mortality in men and women respectively. Novignon, et al. (2012) found that public health expenditure increased life expectancy in SSA. The coefficient of private health spending has a negative and significant link with adult mortality. Thus, indicating that an increase in private health spending by 1% decreased adult mortality rates by about 0.11%. A study by Novignon, et al. (2012) showed that an increase in private health expenditure raised life expectancy. Thus when corruption is controlled, private health expenditure crowds out the effect of public health expenditure on adult mortality. The corruption coefficient is negative and significant. Thus, reducing levels of corruption by 1% decreases adult mortality rates by about 0.18%. Yaqub, et al. (2012) showed that when corruption levels are reduced, life expectancy in Nigeria increased. The other explanatory variables are significant and have right signs.

When the interactions of public and private health expenditure with corruption index are added in model 6, the estimate of public health expenditure is negative while that of a private health expenditure is positive and significantly related to adult mortality. The coefficients of interactive variables (public health expenditure and corruption index (positive) and, private health expenditure and corruption index (negative)) are significant. In Yaqub, et al. (2012) the interaction terms

between public health expenditure and corruption index was negative. The results obtained in model 6 are used to derive the effectiveness of both public and private health expenditure on adult mortality with respect to changes in corruption levels in Table 27.

Table 27: Effectiveness of Public and Private Health Expenditure on Adult Mortality Rates in Sub-Saharan Africa Based on Estimates of Linear Dynamic Panel Model

Corruption Perception Index	**Mean**	**Min**	**Max**
	3	**1**	**6.4**
A. Effectiveness of Public Health Expenditure			
ln (public health expenditure)	-0.295	-0.295	-0.295
Corruption index*ln (public health expenditure)	0.195	0.065	0.416
Net Effect	**-0.100**	**-0.230**	**0.121**
B. Effectiveness of Private Health Expenditure			
ln (private health expenditure)	0.269	0.269	0.269
Corruption index* ln (private health expenditure)	-0.192	-0.064	-0.410
Net Effect	**0.077**	**0.192**	**-0.141**

Calculations based on estimates in model 6 of Table 26.

When the corruption levels are high (for instance, CPI=1) , an increase in public health spending by 1% lowers adult mortality by about 0.23%. On the other hand, a rise in private health spending by 1% leads to an increase in adult mortality by about 0.19%. In situations of low perceived corruption (for instance, CPI=6.4), raising public health spending by 1% increases adult mortality by about 0.12%. On the other hand, increasing private health spending by 1% leads to a fall in adult mortality by about 0.14%.

The above results for the effectiveness of both public and private health expenditure exhibit a substitutability given the corruption levels. One can observe that when there is high corruption public health expenditure is more effective than the private health expenditure. This may occur when citizens are willing to participate in corruption to obtain certain health services (Gupta, et al., 2000). Furthermore, corruption situations like staff absenteeism, in-kind payments and pilferage of drugs might be left unattended to for so long. Hence when such corruption is controlled in the public health sector they transfer their services to the private health sector by referring their

patients to private clinics. This may explain the high effectiveness of private health expenditure when there is low perceived corruption.

4.3 Regional Differences of Health Care Spending in Reducing Adult Mortality Rates in Sub-Saharan Africa

This section examines the regional differences in health care spending (total, public and/or private) and corruption effects on adult mortality rates. The estimation methods used include fixed effects (FE), random effects (RE) and linear dynamic panel data (LDPD). The interpretation of results in all the sections is based on the LDPD estimates. The regression results are presented in Table 28, 29, 30 and 31.

4.3.1 Regional Differences in Effectiveness of Total Health Expenditure and Corruption on Adult Mortality

This section presents the estimated results for regional differences in effectiveness of total health expenditure and corruption on adult mortality. The results are displayed in three models. Model 7 estimates the regional total health expenditure (these are interactions of regional dummy variables Eastern Africa, Western Africa, Central Africa and total health expenditure) effects on adult mortality. Southern Africa dummy variable and all its interactions is used as reference group to avoid the dummy variable trap. In model 8, the regional corruption variables (interaction of regional dummy variables and corruption index) are added to model 7, to measure the regional differences in the impact of corruption reduction in adult mortality. Model 9, extends model 8 by adding the interaction of total health expenditure with regional dummy variables and the corruption index. This is to determine the regional differences in effectiveness of total health expenditure with respect to corruption levels on adult mortality.

The null hypothesis of no joint significance is rejected at the p-value of zero by the Wald test for the three GMM models. Arellano- Bond test finds no serial correlation in the first differenced

Table 28: Regional Variations of Total Health Expenditure and Corruption Influence on Adult Mortality Rates (Dependent Variable is ln (Adult Mortality Rates))

Independent Variables	Model 7			Model 8			Model 9		
	FE	RE	LDPD	FE	RE	LDPD	FE	RE	LDPD
ln (total health expenditure)	-0.078*** (-4.91)	-0.028** (-2.20)	-0.109*** (-5.04)	-0.020 (-0.98)	-0.012 (-0.87)	-0.074*** (-2.80)	-0.017 (-0.85)	-0.011 (-0.81)	0.065*** (3.31)
ln (Real Gross Domestic per Capita)	0.029 (1.05)	-0.060*** (-2.88)	-0.141*** (-4.08)	-0.164*** (-3.36)	-0.148*** (-5.63)	-0.036 (-1.13)	-0.171*** (-3.49)	-0.152*** (-5.74)	-0.185*** (-5.67)
ln (Adult literacy)	-0.107*** (-5.36)	-0.121*** (-6.13)	-0.043* (-1.72)	-0.065*** (-2.66)	-0.078*** (-3.31)	-0.093** (-2.44)	-0.067*** (-2.76)	-0.080*** (-3.44)	-0.158* (-1.68)
HIV prevalence rate	0.032*** (9.06)	0.037*** (13.85)	0.049*** (10.68)	0.050*** (12.78)	0.048*** (17.67)	0.038*** (9.49)	0.050*** (12.84)	0.048*** (17.67)	0.058*** (16.75)
ln(ethnic fragmentation)	-	0.047 (1.45)	0.106*** (3.68)	-	0.042 (1.31)	0.145*** (4.49)	-	0.041 (1.28)	-0.018 (-0.67)
Eastern Africa Dummy	-0.054** (-2.18)	-0.029 (-1.17)	-0.027 (-0.82)	-0.012 (-0.41)	-0.010 (-0.35)	0.043 (1.09)	-0.010 (-0.38)	-0.005 (-0.20)	0.106 (1.51)
Central African Dummy	-	0.335 (0.80)	-1.002* (-1.95)	-	0.727 (1.22)	-2.199*** (-2.97)	-	0.894 (1.54)	0.123 (0.09)
Western Africa Dummy	-	-0.001 (-0.01)	-0.546*** (-2.92)	-	0.040 (0.43)	-0.086 (-0.38)	-	0.063 (0.68)	1.739*** (4.67)
Eastern Africa Dummy* ln (total health expenditure)	0.017 (1.16)	0.0001 (0.01)	0.002 (0.08)	-0.003 (-0.23)	-0.011 (-0.76)	0.043 (1.72)	0.001 (0.09)	-0.008 (-0.49)	-0.084** (-2.00)
Western Africa Dummy* ln (total health expenditure)	0.041 (1.28)	-0.006 (-0.17)	0.407*** (6.43)	-0.009 (-0.23)	-0.016 (-0.44)	0.014 (0.16)	-0.011 (-0.28)	-0.016 (-0.45)	-0.662*** (-4.41)
Central Africa Dummy* ln (total health expenditure)	-0.009 (-0.43)	-0.010 (-0.48)	0.062*** (2.66)	-0.025 (-0.76)	-0.032 (-1.10)	0.086** (2.36)	-0.037 (-1.19)	-0.041 (-1.47)	-0.020 (-0.31)
ln (corruption index)	-	-	-	-0.078*** (-2.85)	-0.090*** (-3.32)	-0.168** (-2.33)	-0.060** (-2.31)	-0.072*** (-2.84)	-0.224*** (-2.99)
Eastern Africa* ln (corruption index)	-	-	-	-0.010 (-0.52)	0.000 (0.00)	-0.124*** (-2.74)	-	-	-

Western Africa * ln(corruption index)	-	-	-	**0.050** (1.36)	**0.046** (1.23)	**-0.239*** (-1.80)	-	-	-
Central Africa * ln(corruption index)	-	-	-	**0.020*** ** (2.87)	**0.193*** ** (2.78)	**0.469*** ** (2.82)	-	-	-
Eastern Africa Dummy*corruption index*ln (total health expenditure)	-	-	-	-	-	-	**-0.0003** (-1.24)	**-0.0002** (-0.68)	**0.0003** (0.34)
Western Africa Dummy*corruption index*ln (total health expenditure)	-	-	-	-	-	-	**0.001** (0.62)	**-0.0004** (-0.52)	**-0.007*** ** (-2.71)
Central Africa Dummy*corruption index*ln (total health expenditure)	-	-	-	-	-	-	**0.005*** ** (2.78)	**0.004*** ** (2.68)	**0.015*** ** (3.34)
Constant	**7.555*** ** (43.38)	**7.025*** ** (35.81)	**8.532*** ** (49.74)	**7.624*** ** (33.92)	**7.156*** ** (32.90)	**7.488*** ** (40.05)	**7.651*** ** (34.06)	**7.158*** ** (32.93)	**6.459*** ** (10.56)
Number of Observations	362	362	362	251	251	251	251	251	251
F-Test, (p-value)	44.48 (0.00)	-	-	37.16 (0.00)	-	-	37.18 (0.00)	-	-
R-Squared	52.9	51.2	-	68.7	68.4	-	68.6	68.4	-
Wald Test χ^2, (p-value)	-	413.31 (0.00)	6661.28 (0.00)	-	548.32 (0.00)	3636.30 (0.00)	-	546.93 (0.00)	480.18 (0.00)
Hausman test χ^2, (p-value)	25.49 (0.00)		-	106.38 (0.00)		-	92.34 (0.00)		-
Sargan Test χ^2, (p-value)	-	-	55.14 (0.14)	-	-	54.837 (0.15)	-	-	43.053 (0.17)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(4) 0.052 (0.96)			AR(6) 0.399 (0.69)			AR(4) -0.875 (0.3)
Number of Instrumental Variables	-	-	57	-	-	61	-	-	51

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model.

2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses.

3) Where p= are the probability values.

4) ***, **, * shows significance levels at 1%, 5% and 10%.

5) Instruments:

Model 7 (four period lagged ln (adult mortality rates) (GMM), three period lagged ln (real income per capita) (GMM), ln (adult literacy) , ln (total health expenditure): levels, four period lagged difference of HIV prevalence rate (GMM), Central Africa dummy, ln (ethnic fragmentation) and Eastern Africa dummy*ln (total health expenditure).

Model 8 (four period lagged ln (adult mortality rates) (GMM), four period lagged ln (real income per capita) (GMM), six period lagged ln (corruption index) (GMM), ln (total health expenditure), ln (ethnic fragmentation), Eastern Africa dummy*ln (total health expenditure) and Eastern Africa dummy*ln (corruption index): levels, four period lagged differenced HIV prevalence rate (GMM), ln (ethnic fragmentation), Eastern Africa dummy, Eastern Africa dummy* ln (total health expenditure), Eastern Africa dummy*ln (corruption index) and the ln (adult literacy).

Model 9 (four period lagged ln (adult mortality rates) (GMM), four period lagged ln (total health expenditure (GMM), ln (ethnic fragmentation), and Eastern Africa dummy*ln (total health expenditure): levels, one period lag differenced ln (corruption index) (GMM), ln (ethnic fragmentation), Eastern Africa dummy and Eastern Africa dummy* ln (total health expenditure).

Table 29: Regional Differences of Total Health Expenditure and Corruption Influence on Adult Mortality Rates

Dummy variables for the Region takes the value of 1; 0 otherwise.								
Computation Based on LDPD Estimates								
Model 7a: Regional Variations of Total Health Care Spending								
ln(Total health expenditure)	**Eastern African Dummy* ln(Total health expenditure)**	**Western African Dummy* ln(Total health expenditure)**	**Central African Dummy* ln(Total health expenditure)**			**Eastern Africa**	**Western Africa**	**Central Africa**
-0.109	0.002*	0.407	0.062			**-0.107**	**0.298**	**-0.047**
Model 8a: Regional Variations of Total Health Care Spending and Corruption								
ln(Total health expenditure)	**Eastern African Dummy* ln(Total health expenditure)**	**Western African Dummy* ln(Total health expenditure)**	**Central African Dummy* ln(Total health expenditure)**			**Eastern Africa**	**Western Africa**	**Central Africa**
-0.074	0.043	0.014*	0.086			**-0.031**	**-0.060**	**0.012**
ln(Corruption Index)	**Eastern African Dummy* ln(Corruption Index)**	**Western African Dummy* ln(Corruption index)**	**Central African Dummy* ln(Corruption Index)**					
-0.168	-0.124	-0.239	0.469			**-0.292**	**-0.407**	**0.301**
Model 9a: Regional Variations of Total Health Spending Efficacy (Interaction -Regional Dummy* Total Health Expenditure* Corruption); Computed using CPI Values at the mean (3)								
ln(Total health expenditure)	**Eastern African Dummy* ln(Total health expenditure)**	**Western African Dummy* ln(Total health expenditure)**	**Central African Dummy* ln(Total health expenditure)**	**Eastern African Dummy*ln(Corruption Index)* ln(Total health expenditure)**	**Western African Dummy*ln(Corruption Index)* ln(Total health expenditure)**	**Central African Dummy*ln(Corruption Index)* ln(Total health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
0.065	-0.084	-0.662	-0.020	0.0003*	-0.021	0.045	**-0.019**	**-0.618**	**0.09**

Note: 1) The computation are based on estimated in Table 28; 2) Mean values of CPI are extracted from the descriptive statistics.

3) The value with asterisks (*) are insignificant in Table 28.

errors. Sargan test fails to reject the null hypothesis, so the over-identification restrictions are valid. Thus, the instruments used in the specification of the GMM models are valid.

All the estimates for the main variables of total health expenditure and levels of corruption in Table 28 are used to derive the regional differences of total health expenditure and corruption influence on adult mortality rates in Table 29.

The baseline model (Model 7a) in Table 29 shows the derived regional differences of total health expenditure effects on adult mortality. The results indicate that impact of total health expenditure on adult mortality is more effective in Southern Africa than the other three regions. Increasing total health expenditure by 1% reduces adult mortality by 0.11% in Southern Africa. In Western Africa increasing total health expenditure raises adult mortality relative to the other three regions. Such that increasing total health expenditure by 1% leads to a rise in adult mortality by 0.3%.

When perceived level of corruption is accounted for in the sub-regions (Model 8a), Southern Africa total health expenditure is more effective in reducing adult mortality than Western, Central and Eastern Africa respectively. On the other hand, increase in total health expenditure in Central Africa raised adult mortality compared to the other three regions. Improvement in quality of governance (low perceived corruption) resulted in lower adult mortality in Western Africa. This was followed by Eastern Africa and Southern Africa respectively. Linking perceived corruption and total health expenditure in model 9a, at average perceived level of corruption (e.g. CPI=3), increasing total health expenditure in Western Africa reduced adult mortality by 0.62%. Making Western Africa to have the most effective total health expenditure relative to the other regions.

The results above reveal that when total health expenditure is dependent on corruption, Western Africa reported lower adult mortality than the other three regions. On the other hand, Central Africa

exhibits worse adult health than the three regions due to low effectiveness of total health expenditure even after controlling for corruption.

4.3.2 Regional Variations in Public and Private Health Expenditure Influence on Adult Mortality Rates

This section discusses the regional variations in effectiveness of public and private health expenditure and corruption on adult mortality reduction in Tables 30 and 31. The variations are discussed using three models. Model 10 is characterised by examining the relation between the regional public and private health expenditure (interaction of regional dummy variable with public and private health expenditure respectively) and adult mortality. Model 11 is extended by adding the regional corruption levels (interaction of corruption index and regional dummy variables). Model 12 augments the two previous models by including the interaction of the regional public and private health expenditure with corruption index. This is to determine the effectiveness of both public and private health expenditure with respect to corruption levels on lowering adult mortality.

Wald test p-value (0.00) indicates that the null hypothesis of no joint significance is rejected in the three GMM models. Arellano-Bond estimates are all insignificant indicating that the first differenced error in the models are not serially correlated. Sargan test estimates are insignificant indicating that the null hypothesis of over identifying restrictions being valid cannot be rejected. Therefore the instruments specified in all three models are valid.

The key variables for public health expenditure, private health expenditure and level of corruption used in deriving the regional variations are all significant and have mixed signs. The estimates of public and private health expenditure and corruption levels are used in Table 31 to compute their regional differences. The calculations in Table 31 correspond to models 10, 11 and 12 in Table 30.

Table 30: Regional Differences of Public and Private Health Expenditure, Corruption Effects on Adult Mortality Rates (Dependent Variable is ln (Adult Mortality Rates))

Independent Variables	Model 10			Model 11			Model 12		
	FE	RE	LDPD	FE	RE	LDPD	FE	RE	LDPD
ln (public health expenditure)	0.009 (0.64)	0.016 (1.21)	-0.194* (-1.92)	0.032** (2.18)	0.026** (2.01)	-0.179*** (-2.59)	0.032** (2.12)	0.025* (1.90)	0.159*** (2.65)
ln (private health expenditure)	-0.064*** (-4.15)	-0.037** (-2.51)	0.116** (2.44)	-0.042*** (-2.82)	-0.033** (-2.55)	0.155*** (3.24)	-0.042*** (-2.72)	-0.031** (-2.27)	-0.164*** (-2.61)
ln (Real Gross Domestic Product per Capita)	-0.001 (-0.05)	-0.066*** (-3.32)	0.066 (1.11)	-0.164*** (-3.64)	-0.150*** (-5.57)	-0.046 (-0.72)	-0.161*** (-3.45)	-0.148*** (-5.65)	-0.026 (-0.67)
ln (adult literacy)	-0.108*** (-5.30)	-0.124*** (-6.17)	-0.243*** (-6.38)	-0.042* (-1.69)	-0.054** (-2.27)	-0.532*** (-3.82)	-0.046* (-1.78)	-0.060** (-2.37)	-0.141*** (-3.64)
HIV prevalence rate	0.035*** (10.25)	0.037*** (14.41)	0.023*** (4.56)	0.051*** (13.95)	0.048*** (17.82)	0.041*** (6.63)	0.051*** (13.62)	0.047*** (17.84)	0.058*** (28.23)
ln (ethnic fragmentation)	-	0.043 (1.33)	-0.009 (-0.13)	-	0.048 (1.43)	0.224* (1.79)	-	0.046 (1.44)	0.219*** (3.84)
Eastern Africa Dummy	-0.014 (-0.16)	-0.047 (-0.56)	-0.507* (-1.91)	0.162** (2.10)	0.155* (1.98)	0.341 (0.77)	0.173** (2.08)	0.172** (2.03)	0.314 (0.73)
Central Africa Dummy	-	0.238 (0.49)	-1.973 (-0.95)	-	1.496* (1.97)	2.593** (2.31)	-	1.664** (2.12)	-0.357 (-0.39)
Western Africa Dummy	-	0.353 (0.86)	-3.759** (-2.00)	-	0.401 (0.86)	0.788 (0.45)	-	0.363 (0.78)	-2.432*** (-2.76)
Eastern Africa Dummy*ln (public health expenditure)	0.004 (0.41)	0.009 (0.85)	0.073*** (2.75)	-0.013 (-1.31)	-0.010 (-0.96)	0.082* (1.95)	-0.013 (-0.51)	-0.016 (-0.63)	0.183 (1.49)
Western Africa Dummy*ln (public health expenditure)	-0.069*** (-3.79)	-0.070*** (-3.80)	-0.167* (-1.99)	-0.085*** (-4.11)	-0.080*** (-3.93)	-0.071 (-0.62)	-0.076 (-0.82)	-0.058 (-0.63)	0.257 (1.10)
Central Africa Dummy*ln (public health expenditure)	-0.060*** (-2.67)	-0.049** (-2.20)	0.106* (1.80)	-0.053** (-2.15)	-0.043* (-1.77)	0.223*** (2.84)	-0.065 (-1.08)	-0.063 (-1.06)	-0.970*** (-2.81)
Eastern Africa Dummy*ln (private health expenditure)	-0.005 (-0.55)	-0.008 (-0.88)	-0.049*** (-2.65)	0.003 (0.34)	-0.001 (-0.06)	-0.092*** (-2.89)	0.002 (0.09)	0.005 (0.21)	-0.205* (-1.66)

Western Africa Dummy*ln (private health expenditure)	**0.034** (1.20)	**0.051**** (1.99)	**0.330***** (3.56)	**0.039** (1.21)	**0.058**** (2.06)	**-0.073** (-0.22)	**0.007** (0.06)	**-0.026** (-0.24)	**-0.160** (-0.67)
Central Africa Dummy*ln (private health expenditure)	**0.061*** (1.69)	**0.045** (1.33)	**-0.010** (-0.11)	**-0.010** (-0.21)	**-0.030** (-0.72)	**-0.314***** (-4.84)	**0.022** (0.36)	**0.043** (0.72)	**0.948***** (2.71)
ln (corruption index)	-	-	-	**-0.092***** (-3.54)	**-0.097***** (-3.79)	**0.406***** (3.52)	**-0.084***** (-3.22)	**-0.093***** (-3.60)	**-0.725***** (-6.25)
Eastern Africa Dummy* ln (corruption index)	-	-	-	**0.012** (0.61)	**0.015** (0.79)	**-0.144*** (-1.89)	-	-	-
Western Africa Dummy* ln (corruption index)	-	-	-	**0.099***** (2.59)	**0.083**** (2.21)	**-0.777***** (-3.14)	-	-	-
Central Africa Dummy* ln (corruption index)	-	-	-	**0.205***** (3.06)	**0.201***** (3.02)	**-0.713**** (-2.37)	-	-	-
Eastern Africa Dummy*corruption index* ln (public health expenditure)	-	-	-	-	-	-	**0.0001** (0.01)	**0.003** (0.32)	**-0.079*** (-1.64)
Western Africa Dummy*corruption index* ln (public health expenditure)	-	-	-	-	-	-	**-0.007** (-0.37)	**-0.006** (-0.30)	**-0.154**** (-1.68)
Central Africa Dummy*corruption index* ln (public health expenditure)	-	-	-	-	-	-	**0.012** (0.25)	**0.009** (0.18)	**0.423**** (2.48)
Eastern Africa Dummy*corruption index* ln (private health expenditure)	-	-	-	-	-	-	**0.0001** (0.01)	**-0.002** (-0.29)	**0.081*** (1.67)
Western Africa Dummy*corruption index* ln (private health expenditure)	-	-	-	-	-	-	**0.009** (0.48)	**0.007** (0.39)	**0.163*** (1.85)
Central Africa Dummy*corruption index* ln (private health expenditure)	-	-	-	-	-	-	**-0.007** (-0.15)	**-0.004** (-0.08)	**-0.405** (-2.38)**
Constant	**7.450***** (40.50)	**6.926***** (33.47)	**8.083***** (44.53)	**7.636***** (31.57)	**6.932***** (29.62)	**7.489***** (10.73)	**7.630***** (29.99)	**6.917***** (29.81)	**6.298***** (10.74)

Number of Observations	362	362	362	251	251	251	251	251	251
F-Test, (p-value)	32.64 (0.00)	-	-	33.00 (0.00)	-	-	27.15 (0.00)	-	-
R-Squared	55.6	54.1	-	72.5	72.2	-	72.4	72.0	-
Wald Test χ^2, (p-value)	-	449.77 (0.00)	11613.72 (0.00)	-	611.23 (0.00)	2107.42 (0.00)	-	603.33 (0.00)	9396.32 (0.00)
Hausman test χ^2, (p-value)	13.69 (0.32)		-	35.87 (0.00)		-	28.79 (0.00)		-
Sargan Test χ^2, (p-value)	-	-	42.832 (0.35)	-	-	29.242 (0.17)	-	-	34.840 (0.18)
Arellano-Bond Autocorrelation test (AR) z-value (p=value)			AR(5) -0.407 (0.68)			AR (6) -0.233 (0.82)			AR(6) -0.127 (0.90)
Number of Instrumental Variables	-	-	56	-	-	43	-	-	51

Notes: 1) FE- Fixed Effects Model; RE- Random Effects Model; LDPD- Linear Dynamic Panel Data Model.

2) t-values are for the FE Estimation, and z-values are for the RE and LDPD estimations are shown in the parentheses.

3) Where p= are the probability values.

4) ***, **, * are significance levels at 1%, 5% and 10%.

5) Instruments:

Model 10 (three period lagged ln (public health expenditure) (GMM), four period lagged ln (adult mortality rates) (GMM), Central Africa dummy* ln (public health expenditure), ln (adult literacy): levels, five period lag differenced ln (real income per capita) (GMM), ln (adult literacy), Central Africa dummy, ln (private health expenditure) and HIV prevalence rates).

Model 11 (six period lagged ln (public health expenditure) (GMM), four period lagged ln (adult mortality rates) (GMM), ln (corruption index), Western Africa dummy*ln (public health expenditure), ln (private health expenditure) and Western Africa dummy* ln (private health expenditure): levels, one period lag differenced HIV prevalence rates (GMM), five period lag differenced ln (real income per capita) (GMM), ln (private health expenditure), Central Africa dummy, Western Africa dummy* ln (private health expenditure).

Model 12 (six period lagged ln (public health expenditure) (GMM) , five period lagged ln (real income per capita) (GMM), Eastern Africa dummy* ln (private health expenditure), Central Africa dummy*ln (public health expenditure), ln (adult mortality rates), Central Africa dummy* ln (public health expenditure* corruption index and ln (adult literacy): levels, five period lag differenced ln (private health expenditure) (GMM), one period lag differenced HIV prevalence rates (GMM), one period lagged differenced ln (corruption index) (GMM), ln (adult mortality rates), Central Africa dummy* ln (public health expenditure)* corruption index and ln (adult literacy)).

Table 31: Regional Differences of Public and Private Health Expenditure and, Corruption Effects on Adult Mortality Rates

Dummy variables for the Region takes the value of 1; 0 otherwise.						
Computation Based on LDPD Estimates						
Model 10a: Regional Variations of Public and Private Health Care Spending						
ln(public health expenditure)	**Eastern African Dummy* ln(public health expenditure)**	**Western African Dummy* ln(public health expenditure)**	**Central African Dummy* ln(public health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
-0.194	0.073	-0.167	0.106	**-0.121**	**-0.361**	**-0.088**
ln(private health expenditure)	**Eastern African Dummy* ln(private health expenditure)**	**Western African Dummy* ln(private health expenditure)**	**Central African Dummy* ln(private health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
0.116	-0.049	0.330	-0.010*	**0.067**	**0.446**	**0.106**
Model 11a: Regional Variations of Public and Private Health Care Spending and Corruption						
ln(public health expenditure)	**Eastern African Dummy* ln(public health expenditure)**	**Western African Dummy* ln(public health expenditure)**	**Central African Dummy* ln(public health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
-0.179	0.082	-0.071*	0.223	**-0.097**	**-0.250**	**0.054**
ln(private health expenditure)	**Eastern African Dummy* ln(private health expenditure)**	**Western African Dummy* ln(private health expenditure)**	**Central African Dummy* ln(private health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
0.155	-0.092	-0.073*	-0.314	**0.063**	**0.082**	**-0.159**
ln(Corruption Index)	**Eastern African Dummy* ln(Corruption Index)**	**Western African Dummy* ln(Corruption index)**	**Central African Dummy* ln(Corruption Index)**			
0.407	-0.144	-0.777	-0.713	**0.263**	**-0.370**	**-0.306**
Model 12a: Regional Variations of Public and Private Health Spending Efficacy (Interaction of Regional Dummy with Public and Private Health Expenditure and Corruption); Computed using CPI Values at the mean=3						

ln(public health expenditure)	Eastern African Dummy* ln(public health expenditure)	Western African Dummy* ln(public health expenditure)	Central African Dummy* ln(public health expenditure)	Eastern African Dummy*ln(Corruption Index)* ln(public health expenditure)	Western African Dummy*ln(Corruption Index)* ln(public health expenditure)	Central African Dummy*ln(Corruption Index)* ln(public health expenditure)	Eastern Africa	Western Africa	Central Africa
0.159	0.183*	0.257*	-0.970	-0.237	-0.462	1.269	**0.105**	**-0.046**	**1.428**
ln(private health expenditure)	**Eastern African Dummy* ln(private health expenditure)**	**Western African Dummy* ln(private health expenditure)**	**Central African Dummy* ln(private health expenditure)**	**Eastern African Dummy*ln(Corruption Index)* ln(private health expenditure)**	**Western African Dummy*ln(Corruption Index)* ln(private health expenditure)**	**Central African Dummy*ln(Corruption Index)* ln(private health expenditure)**	**Eastern Africa**	**Western Africa**	**Central Africa**
-0.164	-0.205	-0.160*	0.948	0.243	0.489	-1.215	**-0.126**	**0.165**	**-0.431**

Source: Author's Estimations.
Note: 1) Mean values of corruption index are extracted from the descriptive statistics.2) The values with asterisks (*) are insignificant in Table 30

In the baseline regional model (Model 10a in Table 31) on effectiveness of public and private health expenditure on adult mortality rate, increasing public health expenditure results in lower adult mortality. But public health expenditure is more effective in Western Africa than the other three regions. For instance, in Western Africa a 1% increase in public health expenditure reduces adult mortality by 0.36%. This is followed by Southern Africa at 0.19%. Turning to private health expenditure, increasing private health expenditure worsen adult mortality rate in all the regions. Therefore, public health expenditure substitutes private health expenditure in all the regions in reducing adult mortality rates.

Adding the corruption perception index in Model 11a, Southern Africa public health expenditure becomes more effective than the other three regions. On the other hand, in Central Africa the coefficient of public health expenditure becomes positive and its private health expenditure coefficient becomes negative. Central Africa has a more effective private health expenditure than the other three regions. All other three regions (Eastern, Southern and Western Africa) have positive private health expenditure indicating that it's worsening adult mortality rates.

The regional differences in effectiveness of public and private health expenditure with respect to average corruption levels is shown in model 12a of Table 31. When faced with average corruption levels (e.g. CPI = 3) public health expenditure in Southern Africa and Central Africa increases adult mortality. However it is different with private health expenditure as it is more effective in reducing adult mortality in the two regions. Raising private health expenditure by 1% in the two regions lowers adult mortality by 0.16% and 0.43% respectively. All the four regions substitute either public health expenditure or private health expenditure in reducing adult mortality rates.

The results in model 12a of Table 31 show that when control of corruption takes effect there are regions that substitute public health expenditure with private health expenditure. This is because if the corrupt health workers or administration are no longer benefitting from the public health system

they may move resources to private health systems to provide better services or the other way round. For example, a physician working in the public health facility may refer a patient to their private pharmacy or even clinic for further diagnosis.

5. Summary, Policy Implications and Conclusions

5.1 Summary

This study examined the link between health expenditure and adult health in Sub-Saharan Africa and how level of corruption influences that relationship. Despite the intergovernmental and development partner's efforts to improve adult health, adult mortality rates in SSA are still higher than the rest of the world. More interventions are needed to reduce premature mortality among the economically active population in SSA. Increasing public health expenditure under the Abuja declaration commitment has been one of the policy directive from the AU heads of states, but it is yet to be fully implemented (Tandon and Cashin, 2010). While increasing health spending will provide more resources to health sectors in SSA this may have little effect on health outcomes if the institutional environment is distorted. There is evidence that levels of corruption in SSA are high.

This study significance arises from the dearth of literature on the link between health expenditure, corruption and adult mortality rates. Most studies concerned with adult health have studied indicators such as life expectancy and maternal mortality rates and linked them with health expenditure in SSA. This paper also provides new evidence of effectiveness of health expenditure given corruption. Yaqub, et al. (2012) work in Nigeria, is the first study measuring effectiveness of health expenditure in Sub-Saharan Africa. This paper applies General Methods of Moments IV linear dynamic panel data model (LDPD) developed by Arellano and Bond (1991), Arellano and Bouver (1995), and Blundell and Bond (1998).

The results of the study indicate that total health expenditure leads to a fall in adult mortality rates significantly across Sub-Saharan Africa. Private health expenditure is more effective in reduction of adult mortality more than public health expenditure. As private health expenditure is increased it reduces adult mortality while raising public health expenditure makes it worse or it is crowded out in Sub-Saharan Africa. Therefore, private health expenditure substitutes public health expenditure. This shows that most adults in the SSA are highly vulnerable in case of high out-of-pocket payments. Reducing corruption levels leads to a fall in adult mortality rates. Curbing corruption levels is likely to influence the effectiveness of health expenditure in reducing adult mortality rates. For instance, when corruption levels are low total health expenditure is more effective in reduction of adult mortality than when there are high corruption levels. When corruption levels are low, private health expenditure is more effective in reducing adult mortality than public health expenditure.

Southern Africa and Eastern Africa have the most effective total health expenditure on adult mortality when the baseline model is used. When corruption level is introduced in the second model, total health expenditure in Southern Africa and Western Africa becomes more effective in reducing adult mortality. Reducing corruption levels was more effective in lowering adult mortality in Western Africa and Eastern Africa than in Southern and Central Africa. When total health expenditure is influenced by corruption (average of SSA corruption levels) reduction in adult mortality was much greater in Western Africa than the other regions.

In the case of public and private health expenditure, all regions have shown that public health expenditure is more effective than private counterpart. In the baseline and the second model (after controlling for corruption), Western and Southern Africa have the highest effectiveness of public health expenditure in reducing adult mortality. Central Africa private health expenditure is more effective in reducing adult mortality than its public health expenditure. Reducing corruption levels

in Western and Central Africa is more effective in lowering adult mortality than in Southern and Eastern Africa. When public and private health are moderated by corruption levels (at the average CPI = 3 in SSA), Western Africa public health expenditure is more effective in lowering adult mortality than Eastern, Central and Southern Africa. On the other hand, private health expenditure in Southern Africa, Eastern Africa and Central Africa is more effective than Western Africa. This shows that public and private health expenditure are substitutes in all the regions when corruption influences their effectiveness on adult mortality.

Increased real income per capita and ability of adult to read and write influenced reduced adult mortality. On the other hand, increased HIV prevalence rates (proxy for new HIV infections) and ethnic fragmentation (low social cohesion) raised adult mortality.

In conclusion, the finding of the study have confirmed that adequate health expenditure plays a significant role in reduction of premature mortality in SSA. Transparency and accountability can enhance efficiency of resources allocated to health care. SSA governments can improve adult health by integrating the health system by ensuring homogeneity in health expenditure and reducing corruption incidences in their respective countries.

5.2 Policy Implications

The issue of strong effectiveness of private health expenditure on adult mortality bring a problem of vulnerability of households to catastrophic health expenditure. Policy makers can alleviate this problem by introducing social protection measures such as voluntary or universal health insurance. This can effectively cover their medical care and also help mitigate against impoverishing risks of high out-of-pocket spending. SSA countries can also renew their efforts in enforcing the Abuja Declaration by allocating more funds to public health sector focusing on adult health care.

Improving transparency and accountability which is likely to reduce corruption is relevant for making systems to work properly and improve health service delivery. Thus as result of improved health service delivery lower adult mortality can be realised in SSA. Regional differences in the effects and effectiveness in health expenditure provides a challenge in integrating health systems in the SSA.

CHAPTER FIVE

SUMMARY AND CONCLUSION

1. Introduction

This chapter presents the summary, conclusion, policy implications and implications for future research. The summary describes the outcomes of the study in general. Policy implications bring about the relevance of the output and possible Sub-Saharan Africa government interventions to curb the high under-five and adult mortality rates. Finally, implications for future research suggests the areas which might be of interest to other researchers in this field.

1.1 Summary and Conclusion

The fundamental agenda for the SSA governments and development partners is to improve human survival at all ages in the continent. Human capital emanating from good health is necessary for high labor productivity and income growth. However, health indicators such as under-five and adult mortality rates are still higher in SSA more than levels set by the Millennium Development Goals (MDGs). Additionally, most of the SSA countries have not complied with Abuja declaration of 2001, under which they agreed to increase their public health spending to 15% of the total government budget. High corruption incidences are also major impediments in public service delivery which includes health care. Inadequate health care spending and misuse of either public funds or principal-agent problem in accessing health care are likely to result to unsatisfactory health outcomes.

Despite the debate about increasing health expenditure and on the effectiveness of health expenditure in SSA, econometric studies on the effects of health expenditure on health outcomes and how the institutional environment influences this link are scarce (Anyanwu and Erhijakpor, 2007; Novignon, et al., 2012; Yaqub, et al., 2012). Against this background the main objectives of

the study are: to investigate the presence of convergence of health expenditure in SSA in the post-Abuja period ; to examine the impact of health expenditure and corruption on child mortality in SSA and its sub-regions; to examine how health expenditure and corruption affect adult mortality in SSA and its sub-regions.

The thesis used panel data for SSA countries covering the post Abuja declaration period (2001-2011). The models estimated improve upon previous studies in several ways. First, convergence model adapted from neoclassical growth model (Solow, 1956; Barro, 1984) was estimated using linear dynamic panel method. There has not been a study for SSA on health expenditure convergence despite the existence of the Abuja declaration target. Second, unlike previous health expenditure convergence in developed countries, this study examined a wide range of health expenditure measures as well as the composition of health expenditure (public and private). Third, the study applied the linear dynamic panel model to conduct a more careful estimation of the impact of health expenditure and corruption on health outcomes. The GMM was used to allow controlling for potential endogeneity and take into account dynamics. This method yields consistent estimates.

The first objective is addressed in chapter 2. The chapter addresses the question of whether health expenditure in SSA exhibited a tendency to converge or diverge since the Abuja declaration of 2001. The chapter tested both absolute and conditional beta convergence of total health expenditure as a percent of GDP; health expenditure per capita; public health expenditure as a percent of government expenditure (Abuja declaration policy instrument) and total health expenditure; and private health expenditure as a percent of total health expenditure. To test for conditional convergence the conditional variables used are whether a country was under the HIPC debt relief, external funding of health from donors, real per capita income and public health expenditure as a percent of government expenditure (Abuja policy instrument).

The results indicate that there exist absolute and conditional convergence in all the health expenditure variables considered. The beneficiaries of HIPC debt relief are more likely to diverge from the equilibrium public health expenditure as a percent of government expenditure, real per capita health expenditure, total health expenditure as a percent of GDP and private health expenditure as a percent of total health expenditure. The exception is the public health expenditure as a percent of total health expenditure where HIPC debt relief led to increase in its convergence rate. Countries benefitting from increased external funding for health care in SSA since the Abuja declaration diverged from the equilibria of real per capita health expenditure and total health expenditure as a percent of GDP. However, external funding for health care does not influence the convergence of public health expenditure as a percent of government expenditure and private health expenditure measures in the study. But, it leads to divergence of public health expenditure as a percent of total health expenditure. Differences in real income per capita lead to divergence in real health expenditure per capita, total health expenditure per capita as a percent of GDP and public health expenditure as a percent of total health expenditure. On the other hand an increase in real income per capita across SSA led to convergence of public health expenditure as a percent of government expenditure and real health expenditure per capita.

When the interactive variables between public health expenditure as a percent of government expenditure and other health expenditure measures are introduced in the conditional convergence model, it has a positive point estimate. The exception to this is private health expenditure as a percent of total health expenditure estimates which is negative. This implies that as countries move from 9.5% (average) to 15% Abuja target threshold the speed of convergence decreases but increases in the case of private health expenditure. Eventually as countries increase their public health expenditure as a percent of government expenditure, countries with lower health expenditure catch up with those with higher expenditures gradually but at a slower rate.

Chapter 3 of this thesis addressed the second objective. It estimates the impact of health expenditure and corruption on child health in SSA using dynamic panel GMM technique. The theoretical framework is the health production approach (Rajkumar and Swaroop, 2008; Yaqub, et al., 2012; Filmer and Pritchett, 1999). The following relationships were investigated; the link between the health expenditure and under-five mortality rates; the effects of corruption on under-five mortality rates; effectiveness of health expenditure (with respect to corruption) on under-five mortality rates; and presence of regional variation in the impact of health expenditure and corruption on under-five mortality rates.

The estimation results indicate that total health expenditure improves survival of children under-five years old. Public health expenditure is significant in reducing under-five child mortality in SSA but it crowds out the effect of private health expenditure on under-five child mortality. This indicates that public health expenditure substitute's private health expenditure in addressing child mortality in SSA. Hence, the contribution of public health expenditure is of high importance in addressing child mortality. Low corruption levels also lead to a decline in under-five mortality. Evidently, when corruption levels are low the effectiveness of public health expenditure in reducing under-five mortality is high.

There exist regional differences in the impact of health expenditure and corruption on under-five mortality rates. Southern Africa has the highest effectiveness of total health expenditure than the other three regions, Eastern, Central and Western Africa. When corruption levels are controlled for, effectiveness of total health expenditure in reducing under-five mortality is higher in Western and Central Africa. When health expenditure are interacted, at the average of corruption levels, Western and Central Africa total health expenditure are more effective in reducing under-five mortality than in Southern and Eastern Africa.

There are also regional differences in effectiveness of public and private health expenditure in lowering under-five mortality. Private health expenditure is more effective in reducing child mortality in Western, Southern and Eastern Africa while in Central Africa public health expenditure is more effective. This implies that in Southern and Eastern Africa private health expenditure substitutes public health expenditure in reducing under-five mortality, while it is the other way round in Central Africa. In Western Africa public and private health expenditure are both effective in lowering under-five mortality. Also in Western Africa, there exist a complementary relationship between public and private health expenditure, though the latter is much stronger in lowering under-five mortality.

When corruption is controlled for in the regions, the effectiveness of private health expenditure is high in Southern and Eastern Africa but it now complements public health expenditure in reducing under-five mortality rather than substitution as before. In Western Africa, both public and private health expenditure are ineffective as their employment in health services increase under-five mortality after taking corruption levels into consideration. In Central Africa public health expenditure remains more effective than private health expenditure in lowering under-five mortality even after controlling for corruption in that region. Lowering corruption levels in Eastern Africa yielded the highest reduction in under-five mortality which was followed closely by Southern Africa but the effects were much lower in Western Africa with Central Africa being the worst. Southern Africa maintains a complementary relationship between public and private health expenditure in the interactive model with corruption. Eastern Africa and Central Africa have public health expenditure which is superior to private health expenditure in reducing under-five mortality but for Western Africa the relationship is the same as previously mentioned.

Increase in real GDP per capita, female labour force participation and measles immunization reduced under-five mortality in SSA. On the other hand increase in female literacy, HIV

prevalence rates (proxy for HIV infections) , total fertility rates (proxy for household size) and ethnic fragmentation (proxy for social cohesion) increased under-five mortality rates in SSA. Female literacy rate may increase under-five mortality because educated mothers are likely to work away from home leaving their children with care takers. This may be precarious to child health due to low nutrition and delay for seeking of emergency health care in case they fall ill when their mothers are not around.

The third objective of the thesis is addressed in chapter 4, which investigates the connection between health expenditure, corruption and adult health in SSA using the health production approach. First, it estimates the impact of health expenditure on adult mortality rates. Second, the impact of corruption on adult mortality rates was investigated. Third, the effectiveness of health expenditure (with respect to corruption) on adult mortality rates was assessed. Finally, the regional differences in the impact of health expenditure and corruption on adult mortality rates were examined.

The empirical results based on dynamic panel GMM technique indicate that an increase in total health expenditure reduces adult mortality in SSA. Private health expenditure crowds out public health expenditure in reducing adult mortality. Curbing corruption levels is necessary for the reduction of adult mortality rates in SSA. Total health expenditure is strong in reducing adult mortality when corruption levels are low than when they are high. Further, effectiveness of private health expenditure when corruption level is low is increased as it reduces adult mortality rates more than public health expenditure. The result for public health expenditure is less clear cut. First, this may imply that when corruption levels are high it is profitable for health workers in the public sector but when it is reduced they shift their productivity to the private health sector. Second, there might be apathy to corruption in the public health sector, as administration and the people consuming the service might see this as normal (Gupta, et al., 2000).

The study also found significant regional differences in the impact of health expenditure and corruption on adult mortality. Southern and Eastern Africa have the most effective total health expenditure in reducing adult mortality than Central Africa and Western Africa. When corruption levels are controlled for, Western Africa total health expenditure become more effectiveness in reducing adult mortality. However, Central Africa total health expenditure worsens the adult mortality when the effects of corruption are introduced in the model. Reducing levels of corruption in Western, Southern and Eastern Africa augurs well with the efforts to reduce adult mortality but it worsens in Central Africa. At average corruption levels in SSA, Western Africa and Eastern Africa, total health expenditure does much better in the decline of adult mortality in the respective regions but it worsens in Southern and Central Africa.

On composition of health expenditure, significant regional differences in effectiveness of public and private health expenditure in reducing adult mortality is also present. Public health expenditure substitutes private health expenditure in all the sub-regions. In Western Africa and Southern Africa, public health expenditure is more effective in reducing adult mortality compared to Eastern and Central Africa. After controlling for corruption levels in the respective regions, Southern and Western Africa still had the most effective public health expenditure, than the other two regions but Central Africa had more effective private health expenditure. Focusing on interactive model with corruption, while Western Africa exhibited higher effectiveness of public health expenditure in reducing adult mortality, Southern Africa and Central Africa had a more effective private health expenditure. Eastern Africa had a complementary relationship between public and private health expenditure but private health expenditure has larger impact. Increased real income per capita and adult literacy reduced adult mortality rate in SSA while high HIV prevalence rates and ethnic fragmentation led to high adult mortality rates.

This thesis examined under-five mortality and adult mortality as outputs of the health care system. It also examined patterns of health spending by testing for convergence. The econometric analysis was conducted using dynamic GMM estimation technique. The main message is that simultaneous increase in health spending and control of corruption would have stronger impact on the two health outcomes. This has to be in the context of increasing per capita income, higher female and adult literacy, low ethnic fragmentation, low fertility rates, low HIV prevalence rates, high female labour force participation and high measles immunization.

1.2 Policy Implications

The relationship between health expenditure, corruption and health outcomes is of interest to policy makers in view of increasing public health spending and reducing high incidence of corruption. The policy implications that have been derived in the study are explained below.

The presence of convergence, provide evidence that the total, public and private health expenditure categories are trending together in SSA. The downward convergence of private health expenditure indicates that they are decreasing and the burden of health care is shifting away from the households. This implies that vulnerability of households is decreasing. Therefore, more efforts by the policy makers are needed to increase effectiveness of public health expenditure in health service delivery in order to cushion the vulnerable in SSA. The over reliance on external partners to finance health in SSA can be reduced by introducing sustainable health financing mechanism.

Sub-Saharan Africa governments should renew their commitment to the Millennium Development Goals by increasing their public health care spending. The public health care spending can be targeted towards health interventions which improve child immunization rates (measles), prevention of mother to child HIV infection and programmes which lower HIV infections among adults and many others. The out-of-pocket component of private health care spending is higher

than the private health insurance component in Sub-Saharan setting. When public health care spending is insufficient to cover health care costs, citizens turn to out-of- pocket expenditure which is detrimental households' welfare. Governments of Sub-Saharan Africa countries can renew their efforts to cushion its citizens from catastrophic health care spending. This can be through introducing a social protection mechanism such as comprehensive universal health insurance or community based health.

From the evidence in the study, SSA government need to increase their effort in anti-corruption campaigns to improve effectiveness of public health resources allocated to health care. Increase in health expenditure without curbing corruption maybe a zero-sum game. Improvement in quality of governance through reduction of corruption is beneficial to promoting child and adult survival. Efficiency in supply of drugs, improving flow of information from the doctors and patients, and reduced embezzlement of health care funds would be essential in reducing corruption. Apathy to corruption related incidences can be discouraged by providing public information on its detriments. Familiarizing citizen of SSA countries on their right to quality health service without prejudice or corruption should be encouraged.

Adult literacy has proven to be important in improvement of health outcomes. Sub-Saharan Africa should invest in basic education for all and develop community health information infrastructure. Educated individuals are more likely to follow health messages such as nutrition, immunization campaigns and prevention messages than the less educated. Women empowerment through labor force participation is very relevant in promoting child health. This is because household income is improved and therefore choices for nutrition and basic health care can be made on time. Women empowerment also reduces household vulnerability to health expenditure shocks.

The governments of Sub-Saharan Africa countries should also endeavour to improve the standard of living of their population through improving their economic growth. Increase in real income

per capita lead to an increase in resources which can be allocated to public service delivery such as health care which improves livelihoods. The Governments of Sub-Saharan Africa can promote family planning services to reduce total fertility rates thus reducing household sizes. Large household size compete for basic essentials such as food and housing. This may leave families not having enough to meet health care needs.

Promotion of social cohesion through equitable distribution of health resources is a pertinent issue to be addressed by Sub-Saharan Africa countries. Sub-Saharan Africa countries have in the last two decades experienced high political conflicts. There is tendency to withdraw resources from areas which do not support a particular political regime. Additionally, when there are social conflicts there is a likelihood of increase in both children and adult mortality. Peaceful coexistence and government goodwill towards the welfare of all its citizen is paramount.

1.3 Implications for Future Research

The corruption perception index used in the study is a measure of corruption at the overall economy level. As data become available it is possible to consider sector-specific corruption measures and other aspects of governance and how they influence effect of health spending on health outcomes. Other quality of governance measures such as resource efficiency, bureaucracy quality and government effectiveness can be tested in the future research in individual SSA countries and the region at large. SSA governments should endeavour to collect sector specific corruption data for example in health sector, to improve future research evidence on its impact on health system performance.

In convergence analysis of health expenditure, further research can be done for Sub-Saharan Africa regional blocks such Western, Southern, Eastern and Central Africa. This is to help determine degree of homogeneity of health care systems in the sub-regions. Furthermore, the level of

corruption in the health sector can also be used as a conditional factor in the convergence analysis of health expenditure estimation. Additionally, convergence analysis can also be done in the pre and post Abuja declaration period to determine the trends to the steady state.

One of the component of public health expenditure is the donor funding (external resources for health as a percent of total health expenditure). Due to lack of data some part of this donor funding is not captured in total health expenditure. Given the extensive role of external funding of health care in SSA when this data becomes available, more accurate and robust evidence is likely to be achieved in future.

For health expenditure, under-five mortality and adult mortality, further studies can be done for individual countries of Sub-Saharan Africa using cross-sectional (within- country regions), time-series and panel data. There is also need to explore more of dynamic panel data estimation methods in Sub-Saharan Africa health economic studies. Income and gender differences in individual or the whole SSA and its regions can be used to extend this topic in future studies. Further disaggregation of public health expenditure into its sub-components such as primary and secondary health expenditure may inform how health expenditure has influenced health outcomes in SSA.

REFERENCES

Abreu, M., de Groot, H.L.F, Florax, R.J.G.M. (2005). A Meta-Analysis of Beta-Convergence: The Legendary Two Percent. Tinberg Institute Discussion Paper TI 2005-001/3.

Aìsa, R, Clemente, J, and Pueyo, F. (2014). The Influence of Health Expenditure on Longevity: A Reconsideration. *International Journal of Public Health.* (online).

Allahdadi, F. and Aref, A. (2011). Human Resource Development for Poverty Alleviation in Iran. *Life Science Journal,* 8(3): 63-66.

Alvarez, J.L., Gil, R., Hernández. and Gil, A. (2009).Factors Associated with maternal Mortality in Sub-Saharan Africa. An Ecological Study. *BMC Public Health,* 9: 462

Amiri, A. and Gerdtham, Ulf-G. (2013). Impact of maternal and Child Health on Economics Growth: New Evidence Based Granger Causality and DEA Analysis. Study Commissioned by the Partnership for Maternal, Newborn and Child Health (PMNCH).

Anand, S. and Ravallion, R. (1993). Human Development in Poor Countries: On the Role of Private Incomes and Public Services. *The Journal of Economic Perspectives*, Vol 7:133-50.

Anyanwu, J.C. and Erhijakpor, A.E. (2007). Health Expenditures and Health Outcomes in Africa. Economic Research Working Paper Series No. 1. Africa Development Bank (AfDB).

Apergis, N., Christou, C. and Hassapis, C. (2013). Convergence in Public Expenditures across EU Countries: Evidence from Club Convergence. *Economics and Finance Research,* 1(1):45-59.

Arellano, M. and Bover, O. (1995). Another Look at the Instrumental Variable Estimation of Error-components Models. *Journal of Econometrics,* 68:29-52.

Arellano, M., and Bond, S.R. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies* 582: 277-297.

Arora, S. (2001). Health, Human Productivity, and Long-Term Economic Growth. *The Journal of Economic History,* 61(3):699-749.

Asaju, K. (2012).Human Capital Development and Poverty Alleviation in Nigeria: A Symbiotic Overview. *Journal of Public Administration and Governance,* 2(4): 110-118.

Aslan, A. (2009). Convergence of Per Capita Health Care Expenditures in OECD. *International Research Journal of Finance and Economics*, 24:48-53.

Auster, R. Leveson, I. and Sarachek, D. (1969). The Production of Health: An Exploratory Study. *The Journal of Human Resources,* 4(4):411-436.

Baldacci, E., Guin-Siu, M.T. and De Mello, L. (2003). More on the Effectiveness of Public Spending on Health Care and Education: A Covariance Structure Model. *Journal of International Development,* 15:709-725.

Baltagi, B.H. and C. Kao. (2000). Nonstationary Panels, Cointegration in Panels and Dynamic Panels: A Survey. *Advance in Econometrics*, 15: 7-51.

Barro, R. J. and Sala-i-Martin, X. (1992). Convergence. *Journal of Political Economy,* 110:223-252.

Barro, R.J. (1984). *Macroeconomics*. First edition. Wiley; New York.

Barro, R.J. (2013). Health and Economic Growth. *Annals of Economics and Finance,* 14(2):329-366.

Barro, R.J. and Lee, J.W. (1994). Sources of Economic Growth. *Carnegie-Rochester Conference Series on Public Policy,* 40 (1):1-46.

Barry, S.P., Somanje, H., Kirigia, J.M., Nyoni, J., Bessaoud, K., Trapsida, J-M., Ndihokubwayo, J.B., Soumbey-Alley, E.W., Nyamwaya, D., Tumusiime, P., Kasilo, O., Diarra-Nama, A.J., Ngenda, C.M. and Sambo, L.G. (2010). The Ouagadougou Declaration on Primary Health Care and Health Systems in Africa: Achieving better Health for Africa in the New Millenium. *Africa Health Monitor Issue*, 12:10-12.

Baumol, W.J. (1986). Productivity growth, convergence and welfare: what the long-run data show. *American Economic Review*, 76: 1072–1085.

Becker, G.S. and Murphy, K.M. (1988). A Theory of Rational Addiction. *Journal of Political Economy*, 96(4):675-700.

Belli, P.C., Bustreo, F. and Preker, A. (2005). Investing in Children's Health: What are the Economic Benefits? *Bulletin of the World Health Organization,* 83:777-784.

Ben-David, D. (1997). Convergence Clubs and Diverging Economies. Berglas School of Economics, Tel Aviv University.

Bernard, A. B. and Durlauf, S.D. (1995). Convergence in International Output. *Journal of Applied Econometrics* 10: 97–108.

Bhalotra, S. (2006). Childhood Mortality and Economic Growth. Research Paper No. 2006/79. UNU-WIDER.

Bhargava, A., Jamison, D. T., Lau, L. J. and Murray, C. J. (2001). Modelling the Effects of Health on Economic Growth. *Journal of Health Economics,* 20(3): 423–440.

Bleakley, H. (2010). Health, Human Capital and Development. *Annual Review of Economic,* 2:283-310.

Bloom, D.E and Canning, D (2003). The Health and Poverty of Nations: From Theory to Practices. *Journal of Human Development,* 4(1): 47-71.

Bloom, D.E, Canning, D and Sevilla, J. (2004). The Effect of Health on Economic Growth: A Production Function Approach. *World Development,* 32(1):1-13.

Bloom, D.E. and Canning, D. (2000). The Health and Wealth of Nations. *Science,* 2000 (287): 1207-1209.

Bloom, D.E. and Canning, D. (2005). Health and Economic Growth: Reconciling the Micro and Macro Evidence. Center on Democracy, Development, and the Rule of Law, Stanford Institute on International Studies Working Paper No.42

Bloom, D.E., Canning, D., Hu, L., Liu, Y., Mahal, A. and Yip, W. (2007). The Contribution of Population Health and Demographic Change to Economic Growth in China and India. Program on the Global Demography of Aging, Harvard School of Public Health Working Paper Series.

Blundell, R. and Bond, S. (1998). Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. *Journal of Econometrics,* 87(1):115-143.

Bokhari, FA.S, Gai, Y. and Gottret, Pablo (2007). Government Health Expenditures and Health Outcomes. *Health Economics,* 16 (3): 257-273.

Boyle, G.E. and McCarthy, T.G. (1997). A Simple Measure of β-convergence. *Oxford Bulletin of Economics and Statistics,* 59:257–264.

Brenner, M.H. (2005). Commentary: Economic Growth is the Basis of Mortality Rates Decline in United States 1901-2000. *International Journal of Epidemiology,* 34:1214-1221.

Bryan, L., Conway, M., Keesmaat, T., McKenna, S. and Richardson, B. (2010). Strengthening Sub-Saharan Africa's Health Systems: A Practical Approach. McKinsey & Company: New York.

Carrion-i-Silvestre, J. and German-Soto, V. (2009). Panel Data Stochastic Convergence Analysis of the Mexican Regions. *Empirical Economics*, 37(2):303-327.

Carrion-i-Silvestre, J.L. (2005). Health Care Expenditure and GDP: Are they Broken Stationary? *Journal of Health Economics,* 24:839-854.

Chatterji, S., Ustün, B.L., Sadana, R., Salomon, J.A., Mathers, C.D. and Murray, C.J.L. (2002). The Conceptual Basis for Measuring and Reporting on Health. Global Programme on Evidence for Health Policy Discussion Paper No.45, World Health Organization.

Clark, D. and Royer, H. (2010). The Effect of Education on Adult Health and Mortality: Evidence from Britain. Working Paper 16013. NBER Working Paper Series.

Commission on Macroeconomics and Health (2001). *Macroeconomics and Health: Investing in Health for Economic Development*. Geneva: World Health Organisation.

Craigwell, R., Lowe, S.and Bynoe, D. (2012). The Effectiveness of Government Expenditure on Education and Health Care in the Caribbean. *International Journal of development Issues,* 11(1):4-18.

Cutler, D, Deaton, A and Lleras-Muney, A. (2006). The Determinants of Mortality. *Journal of Economic Perspectives,* 20(3):97-120.

Dodd, R. Schieber, G., Cassels, A., Fleisher, L. and Gottret, P. (2007). Aid Effectiveness and Health. WHO Making Health Systems Work: Working Paper No.9 WHO/HSS/health systems/2007.2

Dorwick, S. and Delong, J.B. (2003). *Globalization and Convergence*. In Globalization in Historical Perspective. Editors: Bordo, et al. University of Chicago Press; Chicago.

DSAED (2010). The Role of Health in Economic Development. The New Zealand Aid Programme.

EAHP (2013). East African Health Platform Strategic Plan: 2013-2016. East Africa Health Platform; Arusha.

Ehrlich, I. and Lui, F.T. (1991). Intergenerational Trade, Longevity, Intrafamily Transfers and Economic Growth. *Journal of Political Economy,* 99:1029–1059.

Fallahi, F. (2011). Convergence of Total health Expenditure as a Share of GDP: Evidence from Selected OECD Countries. MPRA Paper No.51324.

Fanti, L. and Gori, L. (2013). Endogenous Fertility, Endogenous Lifetime and Economic Growth: The Role of Child Policies. MPRA Paper No. 44898.

Farag, M., Nandakumar, A.K., Wallack, S., Hodgkin, D., Gaumer, G. and Erbil, C. (2013). Health Expenditures, Health Outcomes, and the Role of Good Governance. *International Journal of Health Care Finance and Economics,* 13:33-52.

Farahani, M., Subramanian, S.V. and Canning, D. (2010). Effects of State-Level Public Spending on Health on the Mortality Probability in India. *Health Economics,* 19(11): 1361-1375.

Filmer, D. and Pritchett, L. (1999). The Impact of Public Spending on Health: does Money Matter? *Social Science and Medicine,* 49:1309-1323.

Finlay, J. (2006). Endogenous Longevity and Economic Growth. Program on the Global Demography of Aging Working Paper Series No.7.

Freire, C. and Kajiura, N. (2011). Impact of health Expenditure on Achieving the Health Related MDGs. MPDD Working Papers WP/11/19.

Gani, A. (2008). Health Care Financing and Health outcomes in Pacific Islands countries. *Health Policy and Planning,* 24 (1):72-81.

Gerdtham, Ulf-G. and Löthgren, M. (2000). On Stationarity and Cointegration of International Health Expenditure and GDP. *Journal of Health Economics,* 19:461-475.

Global Fund (2011). *The Global Fund Annual Report 2011*. Global Fund to Fight AIDS, Tuberculosis and Malaria; Geneva.

Global Fund (2012). *The Global Fund Annual Report 2012*.Global Fund to Fight AIDS, Tuberculosis and Malaria; Geneva.

Global Fund (2013). *The Global Fund Annual Report 2013*. Geneva, Switzerland.

Gold, P.O. and Ejughemre (2013). Accelerating Empowerment for Sustainable Development: The need for Health Systems Strengthening in Sub-Saharan Africa. *American Journal of Public Health Research,* 1(7):152-158

Gottret, P. and Schieber, G. (2006). *Health Financing Revisited: A Practitioner's Guide*. World Bank; Washington DC

Grossman, M. (1972). On the Concept of Health Capital and Demand for Health. *The Journal of Political Economy,* 8(20):223-255.

Gupta, S., Davoodi, H. and Tiongson, E. (2000). Corruption and the Provision of Health Care and Education Services. IMF Working Paper WP/00/116.

Gupta, S., Verhoeven, M, and Tiongson, E. (2001). Public Spending on Health care and the Poor. IMF Working Paper WP/01/127.

Gupta, S., Verhoeven, M. and Tiongson, E. (1999). Does Higher Government Spending Buy Better results in Education and Health Care? IMF Working Paper WP/99/21.

Haldar, S. (2008). Effect of Health Human Capital Expenditure on Economic Growth in India: A State Level Study. *Asia-Pacific Social Science Review,* 8(2): 79-97.

Hanushek, E.A. and Kim, D. (1995). Schooling Labour Force Quality and Economic Growth. National Bureau of Research Working Paper 5399.

Health System 20/20 (2012). The Health System Assessment Approach: A How-to Manual, Version 1.75.

Hitiris, T. (1997). Health Care Expenditure and Integration in the Countries of the European Union. *Applied Economics,* 29: 1–6.

Hitiris, T., and Nixon, J. (2001). Convergence in Health Care Expenditure in the EU Countries. *Applied Economics Letters,* 8(4): 223–228.

Hofmarcher, M.M., Rohrling, G. and Riedel, M. (2004). Health Expenditure in the EU: Convergence by Enlargement? Health System Watch, 1/2004, Institute for Advanced Studies, Austria.

Hopkins, S. health Expenditure Comparisons: Low, Middle and High Income Countries. *The Open Health Services and Policy Journal,* 3:111-117

Houweling, T.A.J., Kunst, A.E., Looman, C.W.N and Mackenbach, J.P. (2005). Determinants of Under-5 Mortality among the Poor and the Rich: A Cross-National Analysis of 43 Developing Countries. *International Journal of Epidemiology,* 34(6):1257-1265.

Hu, B. and Mendoza, R.U. (2013). Public Spending, Governance and Child Health Outcomes: Revisiting the Links. *Journal of Human Development and Capabilities: A Multi-Disciplinary Journal for People Centred Development,* 14(2):285-311.

Institute for Health Metrics and Evaluation, Human Development Network and the World Bank (2013). Global Burden of Disease: Generating Evidence, Guiding Policy –Sub-Saharan Africa Regional Edition. University of Washington; USA.

International Monetary Fund (2013). Heavily Indebted Poor Countries (HIPC) Initiative and Multilateral Debt Relief Initiative (MDRI)-Statistical Update. International Monetary Fund; Washington.

Islam, M., ed. (2007). *Health Systems Assessment Approach: A How-To Manual.* Submitted to the U.S. Agency for International Development in collaboration with Health Systems 20/20, Partners for Health Reformplus, Quality Assurance Project, and Rational Pharmaceutical Management Plus. Arlington, VA: Management Sciences for Health.

Issa, H. and Ouattara, B. (2005). The Effects of Private and Public Health Expenditure on Infant Mortality Rates: Does the Level of Development Matters? Economics Department, University of Wales Swansea.

Jewell, T., Lee, J., Tieslau, M. and Strazicich, M.C. (2003). Stationarity of Heath Expenditures and GDP: Evidence from Panel Unit Root Tests with Heterogeneous Structural Breaks. *Journal of Health Economics*, 22:313–323.

Kaufman, D., Kraay, A. and Maztruzzi, M. (2005). *Governance Matters III: Governance Indicators for 1996-2002*. World Bank: Washington, D.C.

Kaufmann, D. and Kraay, A. (2006). Governance Indicators: Where are We, Where Should We be Going? World Bank Policy Research Working Paper WPS4730. Washington, DC: World Bank.

Ke, X. and Saksena, P. and Holly, A. (2011). The Determinants of Health Expenditure: A Country-Level Panel Data Analysis. WHO Working Paper.

Kerem, K., Püss, T., Viies, M., and Maldre, R. (2008). Health and Convergence of Health Care Expenditure in EU. *International Business and Economics Research Journal*, 7(3):29-44.

Lau, M.C.K. and Fung, K.W.T (2013). Convergence in Health Care Expenditure of 14 EU countries: New Evidence from Non-Linear Panel Unit Root Test. MPRA Paper No.52871.

Lewis, M. (2006a). Tackling Healthcare Corruption and Governance Woes in Developing Countries. CGD Brief: Centre for Global Development.

Lewis, M. (2006b). Governance and Corruption in Public Health Care Systems. Centre for Global Development. Working paper No. 78.

Lima, M. A. and Resende, M. (2007). Convergence of Per Capita GDP in Brazil: an Empirical Note. *Applied Economic Letters*, 14:333-335.

Lleras-Muney, A. (2004). The Relationship between Education and Adult Mortality in the United States. Department of Economics, Princeton University.

Lopez, A.D., Mathers, C.D., Ezzati, M., Jamison, D.T., Murray, C.J.L. (2006). *Global Burden of Disease and Risk Factors*. Oxford University Press; New York and the World Bank; Washington D.C.

Lopez-Casasnova, G., Rivera, B. and Currais, L. (2007). Health and Economic Growth: Findings and Policy Implications. *The World Economy,* 30(3):533-534.

Lu, C., Schneider, M.T., Gubbins, P., Leach-Kemon, K., Jamison, D. and Murray, C.J.L. (2010). Public Financing of Health in Developing Countries: A Cross-national Systematic Analysis. *The Lancet*, 375(9723):1375-1387.

Lucas, R.E. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics,* 22:3-42.

Mankiw, N.G., Romer, D. and Weil. D. (1992). A Contribution to the Empirics of Economic Growth. *Quarterly Journal of Economics*, 107(2):407-437.

Montez, J.K., Hummer, R.A. and Hayward, M.D. (2012). Educational Attainment and Adult Mortality in the United States: A Systematic Analysis of Functional Form. *Demography*, 49:315-336.

Muldoon, K.A., Galway, L.P., Nakajima, M., Kanters, S., Hogg, R.S., Bendavid, E. and Mills, E.J. (2011). Health System Determinants of Infant, Child and Maternal Mortality: A Cross-Sectional Study of UN Member Countries. *Globalization and Health,* 7:42

Murthy, V. and Okunade, A. (2009). The Core Determinants of Health Expenditure in the African Context: Some Econometric Evidence for Policy. *Health Policy*, 91(1):57-62.

Narayan, P.K. (2007).Do Health Expenditures 'Catch-up'? Evidence from OECD Countries, *Health Economics*, 16: 993–1008.

Novignon, J., Olakojo, S.A. and Novignon, J. (2012). The Effects of Public and Private Health Care Expenditure on Health Status in Sub-Saharan Africa: New Evidence from Panel Data Analysis. *Health Economics Review*, 2: 22 (online).

O'Connor, J.S. (2013). *Socio-economic Convergence in the European Union: Conceptualisation and Measurement Issues*. In Converging Europe: Transformation of Social Policy in the Enlarged European Union and in Turkey. Eds Vural, I.E. Ashgate: Surrey.

OAU (2001). Abuja Declaration on HIV/AIDS, Tuberculosis and Other Related Infections. African Summit on HIV/AIDS, Tuberculosis and Other Related Infectious Disease, 24th -27th April 2001, Abuja, Nigeria. OAU/SPS/ABUJA/3.

Obrizan, M. and Wehby, G.L. (2012). Health Expenditures and Life Expectancy around the World: a Quantile Regression Approach. Discussion Paper Series No.47. Kyiv School of Economics and Kyiv Economics Institute.

Or, Z. (2000). Determinants of Health Outcomes in Industrialized Countries: A Pooled Cross-Country, Time Series Analysis. OECD Economic Studies No.30.

Panopoulou, E., and Pantelidis T. (2012) Convergence in Per Capita Health Expenditures and Health Outcomes in OECD countries. *Applied Economics,* 44(30):3909-3920.

PEPFAR (2013). PEPFAR Annual Report. 9th Annual Report to Congress. Office of the Global AIDS Coordinator; Washington.

Perron, P. (1989). The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis. *Econometrica,* 57:1361-1401.

Phillips, P. C. B. and Sul, D. (2007a). Transition modeling and econometric convergence tests. *Econometrica,* 75:1771–855.

Pritchett, L. (1996). Mind Your P's and Q's: The Cost of Public Investment is not the Value of Public Capital. Policy Research Working Paper, 1660. Development Economics Research Group, World Bank; Washington D.C.

Rajkumar, A.S. and Swaroop, V. (2008). Public Spending and Outcomes: Does Governance Matter? *Journal of Development Economics*, 86:96-111.

Ram, R. and Schultz, T. (1979). Life Span, Health, Savings and Productivity. *Economic Development and Cultural Change,* 13:399–421.

Romer, P.M. (1990). Endogenous Technological Change. *Journal of Political Economy*, 98(5):S71-S102.

SADC (1999). Protocol on Health in the Southern African Development Community. SADC; Gaborone.

Saikia, N. and Bhat, P.N. M. (2008). Factors Affecting Adult Mortality in India: An Analysis of National Family Health Surveys of 1992-93 and 1998-99 (NFHS I and II). *Demography India* 37(2): 291-302.

Savedoff, W.D. 2006. The Causes of Corruption in the Health Sector: a Focus on Health Care Systems. In: Transparency International. Global Corruption Report 2006: Special Focus on Corruption and Health. London: Pluto Press.

Schneider, M. (2001). The Setting of Health Research Priorities in South Africa: Measuring Health outcomes, Chapter 3. Burden of Disease Research Unit, Medical Research Council South Africa.

Simons, E., Ferrari, M., Fricks, J., Wannemuehler, K., Anand, A., Burton, A. and Strebel, P. (2012). Assessment of the 2010 Global Measles Mortality Reduction Goal: Results from a Model of Surveillance Data.

Solow, R.M. (1956). A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics,* 70: 65–94.

Stenberg, K., et al. (2014). Advancing Social and Economic Development by Investing in Women's and Children's Health: A New Global Investment Framework. *The Lancet,* 383 (9925): 1333-1354.

Strauss, J. and Thomas, D. (1995). Human resources: Empirical Modeling of Household and Family Decisions. In: Behrman, J., Srinivasan, T.N. (Eds.), Handbook of Development Economics, Vol. 3. North Holland Press; Amsterdam.

Tandon, A. and Cashin, C. (2010) Assessing Public Expenditure on Health from a Fiscal Space Perspective. HNP Discussion paper, World Health Organization.

Tatoğlu, F.Y. (2011). The Relationships between Human Capital Investment and Economic Growth: A Panel Error Correction Model. *Journal of Economics and Social Research*, 1391:77-90.

Temah, C.T. (2009). Does Debt Relief Increase Public Health Expenditure? Evidence from Sub-Saharan Africa HIPC. UNECA.

Teorell, J., Charron, N., Samanni, M., Holmberg, S. and Rothstein, B. (2011). The Quality of Government Dataset, version 6. University of Gothenburg the Quality of Government; Gothenburg.

Transparency International (2010). *Corruption Perception Index 2010*. Berlin: Germany.

Transparency International (2013). *Corruption Perception Index 2013*. Berlin: Germany.

UN (2000).*United Nations Millennium Declaration*. New York: United Nations.

UN DESA (2011). World Population Prospects: The 2010 Revision, CD-ROM Edition.

UN Inter-Agency (2012). Child Mortality Estimations 2011. UNICEF; New York.

UNAIDS (2006).*Global HIV/AIDS Response Progress Reports*. Joint United Nations Programme on HIV/AIDS, Switzerland: Geneva.

UNAIDS (2007). *Global HIV/AIDS Response Progress Reports*. Joint United Nations Programme on HIV/AIDS, Switzerland: Geneva.

UNAIDS (2008). *Global HIV/AIDS Response Progress Reports*. Joint United Nations Programme on HIV/AIDS, Switzerland: Geneva.

UNAIDS (2009). *Global HIV/AIDS Response Progress Reports*. Joint United Nations Programme on HIV/AIDS, Switzerland: Geneva.

UNAIDS (2010). *Global HIV/AIDS Response Progress Reports*. Joint United Nations Programme on HIV/AIDS, Switzerland: Geneva.

UNAIDS (2011). *Global HIV/AIDS Response Progress Reports*. Joint United Nations Programme on HIV/AIDS, Switzerland: Geneva.

UNAIDS (2012). *Global HIV/AIDS Response Progress Reports*. Joint United Nations Programme on HIV/AIDS, Switzerland: Geneva.

UNAIDS (2012).*Report on Global AIDS Epidemic*. Joint United Nations Programme on HIV/AIDS (UNAIDS); Geneva.

UNICEF/WHO/World Bank/UNPD/UNDESA. (2012). Level and Trends in Child Mortality. UNICEF; Geneva

United Nations (2011).*The Millennium Development Goals Report 2011*. New York, USA.

United Nations Statistics Division (2013). *Composition of Macro Geographical (Continental) Regions, Geographical sub-regions, and Selected Economics and Other Groupings*. United Nations; New York.

Vian, T. (2008). Review of Corruption in the Health Sector: Theory, Methods and Interventions. *Health Policy and Planning*, 23:83-94.

Vian, T. and Nordberg, C. (2008). Corruption in the Health Sector. Chr. Michelson Institute U4 *issue* 2008:10.

Wagstaff, A. and Claeson, M. (2004). Millennium Development Goals for Health: Rising to the Challenges. The World Bank; Washington D.C.

WAHO (2013), Director-General's report January-December 2012. WAHO/XIV AHM/2013/Doc. Rep 02.

Wang, Z. (2009). The Convergence of Health care Expenditures in the US States. *Health Economics*, 18(1):55-70.

Weil, D.N. (2007). Accounting for the Effect of Health on Economic Growth. *The Quarterly Journal of Economics*, 122(3):1265-1306.

Wexler, A., Valentine, A. and Kates. J. (2013). U.S. Global Health Policy: Donor Funding for health in Low – and Middle-Income Countries 2002-2010.The Henry J. Kaiser family Foundation; Washington.

WHO (1998). *The World Health Report 1998: Life in the 21st Century A Vision for All*. World Health Organization; Geneva.

WHO (2008). *World Malaria Report, 2008*.World Health Organization, Switzerland; Geneva.

WHO (2009). *World Malaria Report, 2009*.World Health Organization, Switzerland; Geneva.

WHO (2010). *World Malaria Report, 2010*.World Health Organization, Switzerland; Geneva.

WHO (2011). *World Malaria Report, 2011*.World Health Organization, Switzerland; Geneva.

WHO (2012). *World Malaria Report, 2012*.World Health Organization, Switzerland; Geneva.

WHO (2013): Global Health Observatory: National Health Accounts. World Health Organization, Switzerland: Geneva.

WHO, UNAIDS and UNICEF. (2011). *Global HIV/AIDS Response; Epidemic Update and health Sector Progress Towards Universal Access Progress Report 2011*. World Health Organization; Geneva.

WHO, UNICEF, UNFPA and World Bank. (2012). *Trends in Maternal Mortality: 1990 to 2010*. World Health Organization; Geneva.

Winters, P. and Chiodi, V. (2011). Oportunidades, Human Capital Investments and Long-Term Poverty Reduction in Rural Mexico. *Journal of International Development*, 23(4):515-538.

Wolfson, L.J., Gasse, F., Lee-Martin, Shook-Pui., Lydon, P., Magan, A., Tibouti, A., Johns, B., Hutubessy, R. Salama, P. and Okwo-Bele, J-M. (2008). Estimating the Cost of Achieving the WHO-UNICEF Global Immunization Vision and Strategy, 2006-2015. *Bulletin of the World Health Organization*, 86 (1):1-80.

Wooldridge, J.M. (2002). *Econometric Analysis of Cross Section and Panel Data*. The MIT Press: Massachusetts.

World Bank (2011). *World Development Indicators, 2011*. World Bank: Washington D.C.

World Bank (2013). *World Development Indicators 2013*. World Bank: Washington D.C.

World Bank (2014). *World Development Report, 2014*. World Bank: Washington D.C.

World Economic Forum (2013). *The Human Capital Report*. Geneva; Switzerland.

World Health Organization (2006). *The World Health Report 2006: Working Together for Health*. World Health Organization; Geneva.

World Health Organization (2008). The Global Burden of Disease 2004 Update. World Health Organization; Geneva.

World Health Organization (2009). Constraints to Scaling Up and Costs. Taskforce on Innovative International Financing of Health Systems. Working Group I.

World Health Organization (2011a). The Abuja Declaration: Ten Years On. World health Organization; Geneva.

World Health Organization (2011b). *Global Disease Burden 2010*. World Health Organization; Geneva.

World Health Organization (2012a). *World Health Statistics 2012*. World Health Organization; Geneva.

World Health Organization (2012b). World Health Statistics: Part III, Global Health Indicators. World Health Organization; Geneva.

World Health Organization (2013). Global Health Observatory Data. World Health Organization; Geneva.

Yaqub, J.O., Ojapinwa, T.V. and Yussuff, R.O. (2012). Public Health Expenditure and Health Outcomes in Nigeria: The Impact of Governance. *European Scientific Journal*, 8(13):190-201.

Zhang, J. and Zhang, J. (2005). The Effect of Life Expectancy on Fertility, Savings, Schooling and Economic Growth: Theory and Evidence. *Scandinavian Journal of Economics*, 107 (1):45-66.

APPENDIX

Table A1:Under-Five Mortality Rates across Sub-Saharan Africa Countries

Countries	Under-Five Mortality rates (Deaths per 1000 live births)			MDG Target	Decline in Under-Five Mortality Rates (%)			Countries	Under-Five Mortality rates (Deaths per 1000 live births)			MDG Target	Decline in Under-Five Mortality Rates (%)		
	1990	2000	2011	2015	1990-2011	1990-2000	2000-2011		1990	2000	2011	2015	1990-2011	1990-2000	2000-2011
Angola	243	199	**158**	**81**	-35	-18	-21	**Ethiopia**	198	139	**77**	**66**	-61	-30	-45
Benin	177	140	**106**	**59**	-40	-21	-24	**Gabon**	94	82	**66**	**32**	-30	-13	-20
Botswana	53	81	**26**	**18**	-51	53	-68	**Gambia**	165	130	**101**	**55**	-39	-21	-22
Burkina Faso	208	182	**146**	**70**	-30	-13	-20	**Ghana**	121	99	**78**	**40**	-36	-18	-21
Burundi	183	165	**139**	**61**	-24	-10	-16	**Guinea**	228	175	**126**	**76**	-45	-23	-28
Cameroon	145	140	**127**	**48**	-12	-3	-9	**Guinea-Bissau**	210	186	**161**	**70**	-23	-11	-13
Cape Verde	58	39	**21**	**19**	-64	-33	-46	**Kenya**	98	113	**73**	**33**	-26	15	-35
Central African Rep.	169	172	**164**	**56**	-3	2	-5	**Lesotho**	88	117	**86**	**29**	-2	33	-26
Chad	208	189	**169**	**69**	-19	-9	-11	**Liberia**	241	164	**78**	**80**	-68	-32	-52
Comoros	122	100	**79**	**41**	-35	-18	-21	**Madagascar**	161	104	**62**	**54**	-61	-35	-40
Congo	119	109	**99**	**40**	-17	-8	-9	**Malawi**	227	164	**83**	**76**	-63	-28	-49
Côte d'Ivoire	151	139	**115**	**51**	-24	-8	-17	**Mali**	257	214	**176**	**86**	-32	-17	-18
Democratic Rep.Congo	181	181	**168**	**61**	-7	0	-7	**Mauritania**	125	118	**112**	**42**	-10	-6	-5
Djibouti	122	106	**90**	**41**	-26	-13	-15	**Mauritius**	24	19	**15**	**8**	-38	-21	-21
Equitorial Guinea	190	152	**118**	**63**	-38	-20	-22	**Mozambique**	226	172	**103**	**75**	-54	-24	-40
Eritrea	138	98	**68**	**46**	-51	-29	-31	**Namibia**	73	74	**42**	**24**	-42	1	-43

Countries	Under-Five Mortality rates (Deaths per 1000 live births)			MDG Target	Decline in Under-Five Mortality Rates (%)			Countries	Under-Five Mortality rates (Deaths per 1000 live births)			MDG Target	Decline in Under-Five Mortality Rates (%)		
	1990	2000	2011	2015	1990-2011	1990-2000	2000-2011		1990	2000	2011	2015	1990-2011	1990-2000	2000-2011
Niger	314	216	**125**	**105**	-60	-31	-42	**Sudan**	123	104	**86**	**41**	-30	-15	-17
Nigeria	214	188	**124**	**71**	-42	-12	-34	**Swaziland**	83	114	**104**	**26**	25	37	-9
Rwanda	156	183	**57**	**52**	-63	17	-69	**Togo**	147	128	**110**	**49**	-25	-13	-14
Sao Tome & Principe	96	93	**89**	**32**	-7	-3	-4	**Uganda**	178	141	**90**	**59**	-49	-21	-36
Senegal	136	130	**65**	**45**	-52	-4	-50	**Tanzania**	158	126	**68**	**53**	-57	-20	-46
Seychelles	17	14	**14**	**6**	-18	-18	0	**Zambia**	193	154	**83**	**64**	-57	-20	-46
Sierra Leone	267	241	**185**	**89**	-31	-10	-23	**Zimbabwe**	79	106	**67**	**26**	-15	34	-37
South Africa	62	74	**47**	**21**	-24	19	-36								

Source of Data: UN Inter-Agency (UNICEF, WHO, World Bank, UNPD and UN DESA) Child Mortality Estimation (2012).

Table A2: Adult Mortality Rates across Sub-Saharan Africa Countries

Countries	Deaths Under-Age of 60 per 1000 alive at age 15			Countries	Deaths Under-Age of 60 per 1000 alive at age 15		
	1995-2000	2000-2005	2005-2010		1995-2000	2000-2005	2005-2010
Angola	426	396	375	**Kenya**	400	456	398
Benin	337	330	316	**Lesotho**	415	610	606
Botswana	415	576	519	**Liberia**	460	413	357
Burkina Faso	349	327	283	**Madagascar**	280	235	198
Burundi	449	447	421	**Malawi**	476	519	443
Cameroon	370	412	413	**Mali**	381	365	338
Cape Verde	168	143	117	**Mauritania**	272	267	264
Central African Rep.	476	520	491	**Mauritius**	182	169	160
Chad	329	355	354	**Mozambique**	415	454	470
Comoros	295	282	269	**Namibia**	325	409	342
Congo	370	367	335	**Niger**	358	330	306
Côte d'Ivoire	408	435	399	**Nigeria**	427	421	396
Democratic Rep.Congo	412	399	389	**Rwanda**	520	414	340
Djibouti	348	340	315	**Sao Tome & Principe**	233	226	216
Equatorial Guinea	364	370	369	**Senegal**	301	288	275
Eritrea	399	358	319	**Sierra Leone**	569	531	471
Ethiopia	361	347	301	**South Africa**	369	490	533
Gabon	270	307	286	**Swaziland**	415	576	569
Gambia	311	297	284	**Togo**	325	336	335
Ghana	286	284	255	**Uganda**	513	486	415
Guinea	397	374	344	**Tanzania**	430	434	385
Guinea-Bissau	408	402	396	**Zambia**	579	603	502
Tanzania	430	434	385	**Zimbabwe**	562	682	638

Source of Data: World Population Prospects (2010).

Table A3: The Countries Used in the Study

Region	**Countries**
Eastern Africa	Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Seychelles, Sudan, Tanzania, Uganda, Malawi, Mozambique, Madagascar, Mauritius and Zambia.
Southern Africa	Botswana, Namibia, Lesotho, South Africa and Swaziland.
Central Africa	Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, Gabon and, Sao Tome and Principe.
Western Africa	Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Mali, Mauritania, Niger, Nigeria, Senegal and Togo.
Data Set for Chapter 2	2001-2011
Data Set for Chapter 3 and 4	2000-2009