HAS QUALITY OF GOVERNANCE AFFECTED THE EFFECTIVENESS OF HEALTH EXPENDITURE ON ADULT HEALTH IN SUB-SAHARAN AFRICA?[12]

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Abstract

Compared to the rest of the world Sub-Saharan Africa (SSA) still has a challenge in reducing its adult mortality. Investments in adult health is a prerogative of SSA governments as they provide the source of labour force, human capital endowment and consumption which are benchmarks of economic growth. Though health expenditure has risen in SSA, quality of governance especially level of corruption is not impressive. The corruption levels are of concern because they may have a negative impact on effectiveness of health expenditure in reducing premature adult mortality in SSA. This study examines interaction of health expenditure and corruption and its effect on adult mortality. Regional differences in the relationship between health expenditure, corruption and adult mortality are also determined across the four regions of SSA: Western, Southern, Central and Eastern Africa. This study has used dynamic panel data model to investigate effectiveness of health expenditure on adult mortality under the influence of corruption. The results indicate that corruption influence positively the effectiveness of public health expenditure while that of private health expenditure is negative. Regional variation exists in the effectiveness of both public and private health expenditure on adult mortality.

Keywords: Health Expenditure, Dynamic Panel, Adult Health, SSA

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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 1. Adult mortality rates have been declining since 1995 all over the world. 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 (ibid.).

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 1). 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. 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, 2011), 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[13] (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. The main purpose of this study is to investigate the relationship between health expenditure an adult health in

[13] 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).

Sub-Saharan Africa, and the role of corruption levels in that relationship. Specifically, estimation of the impact of health expenditure on adult mortality in SSA; whether level of corruption affects the impact of health spending on adult mortality in SSA; and whether there are regional differences in the effect of health care spending and corruption on adult mortality in SSA is done.

This study 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.

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.

Literature Review

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 (2012) 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, 2012), 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.

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.

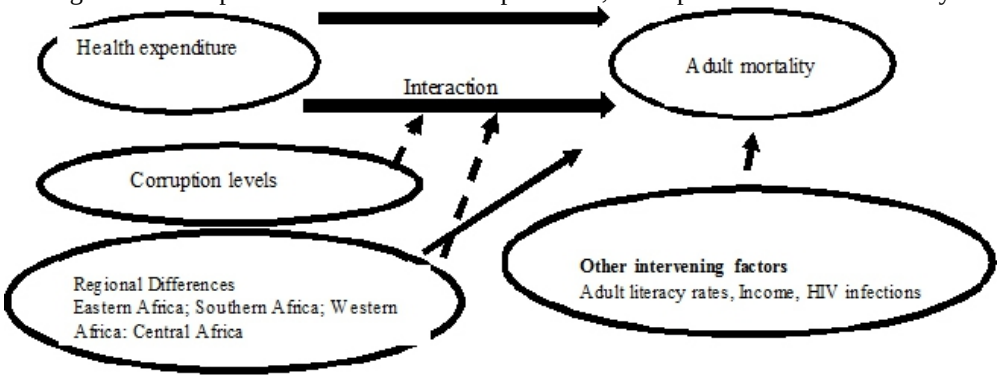
In summary, there is limited literature available on the relationship between health expenditure, corruption and adult mortality. Most of the studies focused on the link between health expenditure and life expectancy or health expenditure and maternal mortality. This study focuses on adult mortality 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.

Methodology

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 1.

Figure 1: Conceptual Model for Health Expenditure, Corruption and Adult Mortality



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).

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.

$M = f\ (\ RGDPC, HEXP, COR)$……...(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.

$M_{it} = A(RGDPC_{it})^{\xi} * (HEXP_{it})^{\psi} * (COR_{it})^{\lambda}$…….....(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.

$ln\ M_{it} = lnA + \xi ln\ RGDPC_{it} + \psi ln\ HEXP_{it} + \lambda ln\ COR_{it}$ …….....(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;

$\phi = \delta(.) *$

ϕ_p……..……..……(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 COR_{it}. Then,

$\delta = \varpi_0 +$

$\varpi_1 C_{it}$…….....…...(4.5)

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

$ln\ M_{it} = lnA + \xi ln\ RGDPC_{it} + \phi_p(\varpi_0 + \varpi_1 COR_{it}) ln\ HEXP_{it} *$

$+\lambda ln\ COR_{it}$ …….....(4.6)

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.

$lnM_{it} = \varrho_0 + \varrho_1 lnHEXP_{it} + X'_{it}\Gamma +$

ε_{it}…….....4.7

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

$lnM_{it} = \zeta_0 + \zeta_1 lnHEXP_{it} + \zeta_2 lnCOR_{it} + X'_{it}\Gamma +$

v_{it}…….....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.

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

μ_{it}…….....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. $\varrho_1, \zeta_1 \; and \; \eta_1$ are the coefficients of health expenditure and are expected to be negative. $\zeta_2 \; and \; \eta_2$ 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.

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

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

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

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.

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

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.

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. Table 2 describes the variables used in the study and their data source.

Empirical Results

Descriptive Statistics

This section presents the descriptive statistics for all variables used in the study. From Table 3, 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. 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 shows. 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.

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

The econometric estimates are shown in Table 4. A baseline model relating public and private health expenditure to adult mortality rates is shown in Model 1. Model 2 augments model 1 by adding corruption index to determine its effects on adult mortality rates. Model 3 extends model 2 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.

In model 1 (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 2 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 3, 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 3 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 5. 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.

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

This section discusses the regional variations in effectiveness of public and private health expenditure and corruption on adult mortality reduction in Tables 6 and 7. The variations are discussed using three models. Model 4 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 5 is extended by adding the regional corruption levels (interaction of corruption index and regional dummy variables). Model 6 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 7 to compute their regional differences. In the baseline regional model (Model 4a) 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 5a, 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 6a. 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 6a 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.

Conclusion

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 Bover (1995), and Blundell and Bond (1998).

The results of the study indicate that 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.

In regional variations, public and private health expenditure in 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. 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. 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. 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.

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Table 1: 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).

Table 2: 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
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 of HIV refers to the percentage of people	World

Prevalence Rate	ages 15-49 that are infected with HIV.	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)

Table 3: 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$)	410	1,130	3,490	7.4	23,500
Real GDP per Capita (2005, PPP International US$)	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

Table 4: Effects of Public and Private Health Expenditure, 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 (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)			-0.369 (0.71)			0.869 (0.39)			-0.765 (0.44)

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.

Table 5: 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 3 of Table 4.

Table 6: Regional Differences of Public and Private Health Expenditure, Corruption Effects 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)	**0.009** (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)	11613.7	-	611.23 (0.00)	2107.4 (0.00)	-	603.33 (0.00)	9396.32

			(0.00)						(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)			-0.407 (0.68)			-0.233 (0.82)			-0.127 (0.90)

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.

Table 7: 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 4a: Regional Variations of Public and Private Health Care Spending			
Southern Africa	Eastern Africa	Western Africa	Central Africa
-0.194	-0.121	-0.361	-0.088
Southern Africa	Eastern Africa	Western Africa	Central Africa
0.116	0.067	0.446	0.106
Model 5a: Regional Variations of Public and Private Health Care Spending and Corruption			
Southern Africa	Eastern Africa	Western Africa	Central Africa
-0.179	-0.097	-0.250	0.054
Southern Africa	Eastern Africa	Western Africa	Central Africa
0.155	0.063	0.082	-0.159
Southern Africa			
0.407		-0.370	-0.306
Model 6a: 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			
Southern Africa	Eastern Africa	Western Africa	Central Africa
0.159	0.105	-0.046	1.428
Southern Africa	Eastern Africa	Western Africa	Central Africa
-0.164	-0.126	0.165	-0.431

Source: Author's Estimations. Note: 1) Mean values of corruption index are extracted from the descriptive statistics.