IMPROVING HEALTH OUTCOMES TOWARDS INCLUSIVE SUSTAINABLE DEVELOPMENT IN AFRICA: DO HEALTH EXPENDITURES MATTER?

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Improving Health Outcomes towards Inclusive Sustainable Development in Africa: Do Health Expenditures Matter?

ABSTRACT

This study investigates whether health expenditure matters for health outcomes, towards a sustainable development in Africa from 2000 to 2016. Three indicators of health outcomes (life expectancy, under-5 mortality and infant mortality rates) were utilized. Using the system GMM estimator, health expenditure was found to increase life expectancy, and reduce both under-5 and infant mortality rates respectively. Health expenditure was found to matter for all three health outcomes in the study. Under the period of investigation, health expenditure was found to exert a direct and significant impact on life expectancy and a negative and significant impact on under-5 and infant mortality rates. On one hand, real income, openness, ethnic fractionalization and education were positively associated with life expectancy while Co2 emission, corruption and urbanization exerted a negative effect. The effect of real income, openness, urbanization and education were negative for under-5 and infant mortality rates, while Co2 emission and corruption led to their increase. Whereas ethnic fractionalization exerted a significant negative effect on infant mortality rates, it was not a significant factor affecting under-5 mortality rates. The evidence is that health expenditure matters for health outcomes in Africa, and policy should be directed towards improving expenditure on health, given the imperative of a healthy population for inclusive sustainable development.

Keywords: Africa**,** Health expenditure, Infant mortality, Life expectancy, System GMM, Under-5 mortality

JEL Classification Codes: H51, I10, I12, I18

INTRODUCTION

Health is one of the most valued aspects of the life of citizens, not only because health status matters in itself, but also for helping them to achieve other dimensions of well-being, including employment, adequate income, and ability to fully participate in community life. It has been stressed that heath being an integral part of sustainable development, improving health outcomes should always be a country's main development goal (WHO, 2000). Not only does good health engender economic security for individuals and their families (Sen, 1999), investing in the health sector positively impacts the economy (Bloom, Canning & Sevilla, 2004). WHO (2010) reported that a rise in life expectancy at birth by 10% resulted in 0.35% increase in economic growth rate per year. The implication of this is that by ensuring that life expectancy improves through investment in health, economic growth is ensured, a useful point to consider in the inclusive sustainable development paradigm.

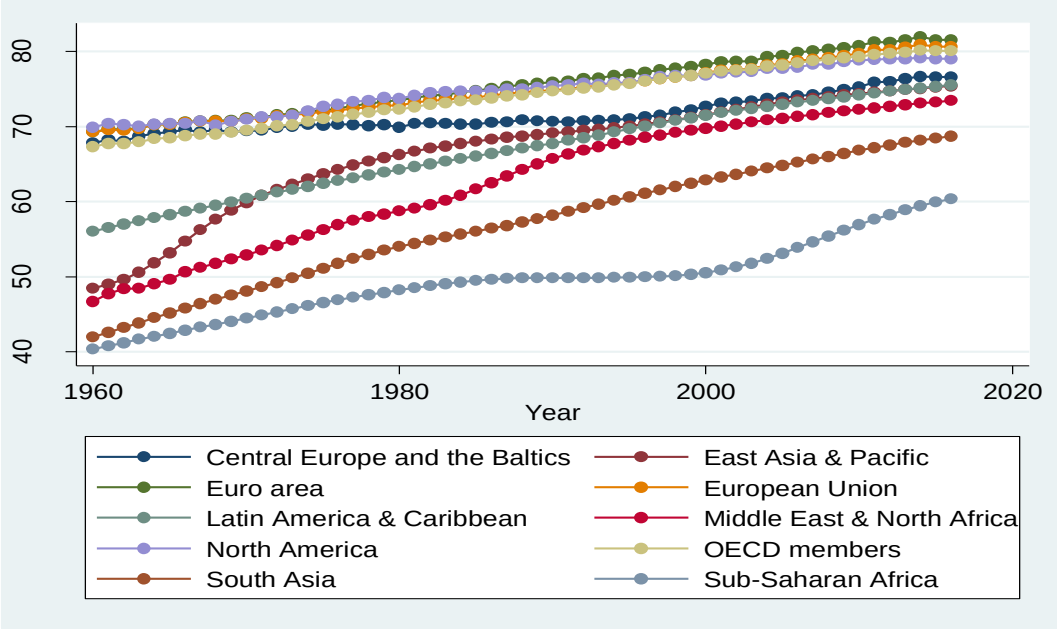
The centrality of health to the development of nations is reflected in the *Millennium Development Goals*, with three out of the eight goals focused on health. Central to the three dimensions of sustainable development (economic, social and environmental), health both benefits as well as contributes to development and consequently a key indicator of what inclusive development seeks to achieve (WHO, UNICEF, the Government of Sweden and the Government of Botswana, 2013). In addition, spirited efforts made at investing in health systems were demonstrated in the *2030 Agenda for Sustainable Development and the Tallinn+10*, where actors were implored to "intensify efforts to bring health and finance decision-makers together around

shared goals by taking note of public finance objectives and correspondingly demonstrating the economic and social returns of investing in health systems" (WHO Regional Office for Europe, 2018). In light of this, public health expenditure is most likely to engender accelerations in growth, while investing in human capital is critical for long-term growth *(*IMF, 2015).

In the macroeconomic literature, improvements in human and health capital are emphasized as critical to economic growth and development (López-Casasnovas, Rivera & Currais, 2005). In light of this, Africa's quest for inclusive sustainable development will benefit from the imperative of a healthy population, given the role of good health in individuals' consumption and production. In poor regions where resources are relatively scarce, health expenditure has hardly received the desired attention in national budgets. Despite the imperatives of health to development, Africa has fared poorly in terms of health expenditures, even though poor regions have generally paid less for health. For example, Africa accounted for a paltry 3% of the world's health expenditure, although it contained about 10% of the world's population, compared to Asia and the Pacific (including China), which had about 30% of the world's population, while it accounted for only 4% of the world's health expenditure (Poullier, Hernandez, Kawabata & Savedoff, 2002; WHO, 2015).

By improving health outcomes in Africa, its citizens may be able to contribute to the economy through four mechanisms as identified by Bloom and Canning (2003), namely: greater productivity at the workplace, leading to improved income, (ii) ability to retire later and work much longer due to overall good health, (iii) more likelihood at investing in their own education and training, resulting in enhanced productivity; and (iv) greater capacity to save and invest more with the expectation of a longer life. Interestingly, Africa has compared relatively poorer than virtually other regions of the world in several health outcome indicators, including life expectancy, under-5 mortality and infant mortality rates. To fix ideas, figure 1 presents the trend of life expectancy in different parts of the world from 1960 to 2016.

Figure 1: Life expectancy around the World (1960-2016)



Source: Developed from World Bank data (2019)

It can be seen from figure 1 that compared to other regions, life expectancy in Africa (as indicated by Sub-Saharan Africa and Middle East & North Africa) has historically been the lowest in the world. For example, in 1960 life expectancy in Sub-Saharan Africa (SSA) was 40.38 compared to Central Europe and the Baltics (67.82), East Asia & Pacific (48.46), Euro area (69.27), Latin America & Caribbean (56.05), North America (69.89) and OECD members (67.36). Although the figure has increased across the world since 1960, Africa has hardly kept pace with the rest of the world. In 2016 for instance, whereas life expectancy in Central Europe and the Baltics was 76.60, East Asia & Pacific 75.40, Euro area 81.56, Latin America & Caribbean 75.54, North America 79.05 and OECD members 80.11, that of SSA was 60.39.

Inclusive sustainable development being economic growth with a focus on equal participation and equitable access to resources, the role of health outcomes in its realization, engineered by adequate expenditures on health is critical. Given the long-term objectives of development such as poverty reduction, human development, and sustainability, the imperative of the overall status of health in any country cannot be overemphasized. In this context, this paper investigates the impact of health expenditures on three health outcomes, as a first approximation towards inclusive development inclusivity for Africa. Additionally, the debate on the relationship between health care expenditure and health outcomes is still inconclusive (Novignon, Olakojo & Nonvignon, 2012), and therefore remains an empirical question. This study contributes to this debate methodologically using the system GMM technique. Importantly, it considers the impact of corruption in the health expenditure- health outcomes nexus for Africa, a novelty in the empirics. In addition, this study has controlled for other factors, including real income, CO2 emission (environmental quality), openness (globalization), ethnic fractionalization, urban population (a measure of urbanization) and education, all of which are factors that can impact health outcomes, based on the literature.

Following the introduction, the paper is structured in the following order. Section two is on literature review. The methodology is presented in section three. The empirical results are presented and discussed in section four. The paper is concluded in section five.

LITERATURE REVIEW

It has been found that better health outcomes result from health system spending especially where current spending levels are low (Nolte et al., 2011). Claxton et al. (2015) found that an extra spending of about GBP 13 000 would bring about an extra quality-adjusted life year in England. This is particularly relevant for Africa, where mortality rates are high and life expectancy figures considerably lower than other regions. Because increased health expenditure reduces mortality rates (Mackenbach et al., 2017), and while it costs just USD 150 for an additional quality-adjusted life year in low and middle-income countries (Moreno-Serra & Smith, 2015), there is likelihood that a rise in health expenditure in low income countries would have much more profound impact on health gains than in high income countries. Thus, expenditure on health systems is a demonstration of responsible utilization of public resources in poor countries.

Empirical evidence from the OECD, indicates that between 1991 and 2003, increases in health spending explained 46% of male and 39% of female gains in life expectancy at birth (Joumard et al., 2008), while as at 2017 it was found that on average, a 10% increase in health

expenditure is associated with 3.5 additional months of life expectancy (OECD, 2017). Consequently, government spending plans which target improvement in health outcomes can lead to improved quality of life via higher life expectancy. Because health is an economic good, which requires allocation of public resources, it calls for policy choices which give emphasis to raising the quality of life of citizens. A positive relationship was reported between health expenditure and life expectancy by Jaba, Balan and Robu (2014) in a cross-country and time-series examination, irrespective of their level of income level. In a study involving 193 countries, Ranabhat, Atkinson, Park, Kim and Jakovljevic (2018) reported a positive effect of universal health coverage (in which expenditure on health is a major part), on life expectancy.

The impact of health expenditure on life expectancy is not however regular in the literature. On the determinants of life expectancy in 31 European countries, Heuvel and Olaroiu (2017) concluded that health expenditure is not a main factor. Filmer and Pritchett (1997) and Barlow and Vissandjee (1999) found that an increase in total health expenditures had no impact on life expectancy at birth. Zakir and Wunnava (1999) and Young (2001) did not find significant and consistent relationship between health expenditure and health outcomes. Some have suggested that the relationship between health expenditures and life expectancy is weak or insignificant (e.g., Barlow and Vissandjée, 1999; Nixon and Ulmann, 2006; Bidzha, Greyling and Mahabir, 2017).

In the context of panel setting, only a few studies have been conducted on Africa. Anyanwu and Erhijakpor (2007) in a study covering 1999 to 2004 on 47 African countries found that the effect of total healthcare expenditure on health outcomes was significant, and reported that 1% increase in total health care expenditure per capita, led to 2.1% and 2.2% reduction in under-five and infant mortality rates, respectively. In the same vein, Akinkugbe and Afeikhena (2006) reported a significant positive effect of health care expenditure on life expectancy, under-five mortality, and infant mortality in SSA and MENA countries. Additionaly, Arthur and Oaikhenan (2017) conducted a study on 40 countries in sub-Saharan Africa and found a significant but inelastic effect of health expenditure on health outcomes, with increased health expenditure marginally improving life expectancy, and linked with private health expenditure. On East African countries, Bein, Unlucan, Olowu and Kalifa (2017) found a positive effect of total health expenditure on life expectancy, and an indirect relationship between healthcare expenditure and mortality rate.

Several studies have been done on the effect of healthcare spending on infant and child mortality rates. In an earlier study, Cochrane et al. (1978) found that a rise in cigarette and alcohol consumption, and the number of doctors led to increases in infant mortality rates, while increases in population density, income and sugar consumption reduced infant mortality. Hitiris and Posnett (1992) found that an increase in healthcare expenditure was associated with a reduced infant mortality rates. Crémieux et al. (2005) found that lower healthcare spending increased infant mortality rates but reduced life expectancy. Nixon and Ulmann (2006) on 16 European Union countries for the period of 1980 to 1995 concluded that healthcare expenditure, including the number of physicians were significant in reducing infant mortality, while having a relatively marginal contribution to life expectancy.

On environmental quality, Pope, Ezzati and Dockery (2009) in a study of the United States found that a fall in fine particulate air pollution significantly increases the mean life expectancy throughout the country. Similarly, Chen, Ebenstein, Greenstone and Li (2013) found that places with higher exposure to pollution recorded less life expectancy. In a study on China, involving data on pollution concentration in 90 cities from 1981 to 2000, the authors reported

that life expectancy was five and a half years less in the north than in the south, as its pollution rate was 55% higher.

Several studies have implicated the institutional environment on health outcomes. Wagstaff and Claeson (2005) linked increased spending to under 5 mortality reduction where the institutional quality is sound. Kerman and Basakha (2009) investigated the link between good governance (proxied by corruption and the quality of bureaucracy), public health spending and social outcomes. They reported that public expenditure on education and health was more effective in countries with good governance compared to those where governance was poor. Consequently, the impact of health expenditure on infant mortality was stronger when good governance existed. In a similar vein, Farag et al. (2013) found that government healthcare spending significantly reduced infant and child mortality and that the magnitude of the coefficient is dependent on the governance quality, the effectiveness of healthcare expenditure being influenced by the quality of governance, leading to improved health outcomes. Similarly, Hu and Mendoza (2013) in a study involving 136 countries from 1960 to 2005 reported that both healthcare expenditure and the quality of governance are critical in reducing child mortality rates.

In terms of corruption as an institutional indicator, the evidence in the literature is that it adversely affects health outcomes. Gupta, Davoodi and Tiongson (2000) reported that corruption indicators had negative association with child and infant mortality, the probability of an attended birth, immunization coverage and low-birthweight. Although the correlation between corruption and the same health outcomes is reduced after controlling for maternal education, public health and education expenditure and urbanization, it was still significant. Similarly, Rajkumar and Swaroop (2002) found that the effectiveness of health expenditure in reducing child mortality is dependent on the integrity rating (1-5 range based on corruption perception level), with higher integrity associated with lower mortality, even after controlling for several factors including GDP per capita, female educational attainment, ethno-linguistic fractionalization and urbanization. However, Filmer and Pritchett (1999) using country-level cross sectional data investigated the impact of both public expenditure on healthcare and non-health factors on child and infant mortality rates, and reported that public expenditure on healthcare did not affect mortality rates across countries, as 95% of the variation in mortality rates were due to factors other than healthcare spending.

From the literature reviewed, it can be seen that most of the studies on healthcare expenditure were carried out without considering the role of the institutional environment and openness.

METHOD AND DATA

The Model

The study uses a health production function model in the theoretical tradition of Grossman (2001) and Pruckner (2010), but augmented to include other variables within a panel setting.

The health outcomes equation is specified as follows:

$$HO_{it} = \beta_0 + \beta_1 Health\ Exp_{it} + \beta_2 Income_{it} + \beta_3 CO2_{it} + \beta_4 Corr_{it} + \beta_5 Open_{it} + \beta_6 Eth\ Frac_{it} + \beta_7 Urban_{it} + \beta_8 Edu_{it} + \mu_{it} \quad (1)$$

where:
Ho_{it} = Health outcome (life expectancy, under-5 mortality or infant mortality rate);
$Health\ Exp_{it}$ = Health expenditure
$Income_{it}$ = GDP per capita
$CO2_{it}$ = Carbon emission per capita
$Corr_{it}$ = Corruption
$Open_{it}$ = Openness
$Eth\ Frac_{it}$ = Ethnic fractionalization
$Urban_{it}$ = Urban population
Edu_{it} = Education

The study uses the system GMM and has avoided the pooled OLS regression due to the preponderance of biased and inconsistent estimates. Moreover, pooled OLS does not differentiate amongst the cross-sections (countries in this study) in terms of individual heterogeneity, fixed and time varying effects, their structural peculiarities, while the individualities of the cross-sections are subsumed in the error-term. Due to these shortcomings, the fixed effect (FE) estimator is better than the pooled OLS regression. However, OLS estimation of FE is not free from bias and inconsistency.

The period of investigation in the study (2000-2016) calls for dynamism in the estimated model. It is known that a failure to incorporate dynamic component into a model may result to serious misspecification biases. One way to reflect dynamism is to incorporate lagged dependent variable as an independent variable, but this can bring about the econometric problem of endogeneity which cannot be addressed using OLS estimator without encountering biased and inconsistent estimates. For example, income is one of the explanatory variables used in this study. However, observed positive associations between income and health do not necessarily reflect causation from income to health due to the potential endogeneity of income. Third factors might exist such as living environment, education, genetics or access to better health care, which might explain why some people have better health than others. In the same vein, there is the potential for reverse causality, given that changes in health outcomes can influence people's income. One way to address this is to employ the dynamic generalized method of moment (GMM).

Following Arellano and Bover (1995) and Blundell and Bond (1998) approaches, this study employed the two-step system GMM. The system GMM is robust for unbalanced panel and superior to the fixed, random effects and pooled least square (OLS) techniques. By using GMM, this study has controlled for unobserved individual heterogeneity, the problem of endogeneity problem, Nickell bias, reverse causality or simultaneity bias, omitted variable bias, measurement error, heteroskedasticity and autocorrelation, while reducing finite sample biases.

The data is characterized by small T and large N, conditions that are necessary for a correct implementation of system GMM (see Roodman, 2009). To treat endogenous variables, the standard practice is to use 2 lags and more lags for the transformed equation, while 1 lag is used for the levels equation. However, the number of instruments must not be more than the number of groups. One way to avoid having the number of instruments exceeding the number of groups is to instrument endogenous variables with fewer lags. Otherwise, the Sargan and Hansen

tests (employed to indicate whether the instruments are jointly valid, i.e. if they are uncorrelated with the error term) become weak, leading to unreliable estimations. It should be noted that for the instruments to be valid, the p-values of the Sargan and the AR(2) tests should be greater than 0.1 (i.e. 10%), or put another way, not statistically significant. A perennial problem in the empirical research is weak tests and proliferation of instruments. To address such problems, Roodman (2009) suggested that one could restrict the set of instruments to certain lags, collapse the set of instruments or combine the two solutions.

In this study, a baseline model was first estimated linking the two variables of interest, i.e. health expenditure, and health outcome (life expectancy, under-5 mortality or infant mortality rate). Thereafter, the baseline model is extended to control for other variables earlier described, to determine whether the health expenditure outcome would be different (in sign and significance) from what was obtained in the baseline estimates. However, the analysis and discussion in the study are based on the extended model.

Data, variables and Sources

The paper used panel data covering 2000 through 2016 on 49 African countries (see Appendix 1 for the list of countries). The choice of period is underpinned on availability of data. The variables employed in the study are described.

Life expectancy: It is defined as the mean number of years a new-born child is expected to live if subjected throughout their life to the current mortality conditions.

Under-5 mortality: Mortality rate, under-5 per 1,000 live births.

Infant mortality: Mortality rate, infant per 1,000 live births.

Health expenditure: The measure of health expenditure in the study is current health expenditure (as % of GDP), encompassing healthcare goods and services consumed during each year, and excluding capital health expenditures. Health expenditure also acts as a proxy for the level of human capital. It is expected that a healthier population will contribute more meaningfully to the economic aspirations and enjoy better life.

Real income: Improved income enhances one's capacity to access both private and public health facilities. Some studies have shown that people who earn lower incomes live shorter lives. For example Braveman, Egerter and Barclay (2011) reported that at 25, American citizens who are in the highest income group can expect to live longer than their poor counterparts by more than six years. In the same vein, it was reported that the life expectancy of those with earnings in the top half of the income distribution increased by more 6 years than those in the bottom half (Waldron, 2007). In addition, health burden is a major issue to the poor, and as reported by Duraisamy and Sathiyavan (1998), the poor bear a disproportionately higher burden of injury, disease and illness compared to the rich. For example, the level of poverty is identified as one of the factors determining child mortality (Filmer & Pritchett, 1997; Currie & Moretti, 2003; Alve & Belluzzo, 2005). This partly accounts for why low income countries, encumbered by low spending, experienced higher infant/child mortality rate, compared with higher income countries (Maruthappu, Ng, Williams, Atun, & Zeltner, 2015).

CO2: This is used as a measure of environmental quality. Poor environmental quality embodied for instance in rising pollution can adversely affect health. Epidemiological studies show that air pollution combustion adversely affects four categories of human disease categories, including chronic respiratory disease, cardiovascular disease, diabetes mellitus and cancer. A study by IPCC (2018) indicated that CO2 is the major gas responsible for climate change, a condition that raises a lot of health issues. The relationship between CO2 emissions and human health was demonstrated by Mohmmed et al. (2019) in a study involving the top ten emitting countries from 1991 to 2014. Hersoug, Sjödin and Astrup (2012) showed that atmospheric CO2 is a risk factor for obesity and diabetes mellitus. Rasoulinezhad, Taghizadeh-Hesary and Taghizadeh-Hesary (2020) reported that the highest variability of mortality was explained by CO2 variability, confirming a similar result earlier found by Bell, Dominici and Samet (2005). On its impact on mortality in Africa, Shobande (2019) found that a rise in co2 emission has significant effect on child mortality.

On the future, it is projected for example that global average temperatures will increase by about 3.5^0C by 2100 due to CO2 emissions, well above the 2^0C threshold for dangerous climate change (Climate Action Tracker, 2012), and this is despite rapid decarbonisation and a revolution in green growth. Colossal economic losses are likely to result from extreme weather changes. In Asia alone, 125 million people are projected to be exposed to tropical cyclones by 2030 (Peduzzi et al., 2012). With the world requiring at least 50% more food and 30% more water by 2030 (High Level Panel on Global Sustainability, 2012), and agriculture accounting for about 70% of water withdrawals, and the doubling of water extraction from rivers and lakes since 1960 (Turral, Burke, & Faures, 2011), the risks of food shortages due to reduced yields are high. Unless mitigating measures are adopted, all of these will have devastating impacts on health outcomes.

Corruption: This was used a proxy of the institutional environment, captured in the corruption perception index (CPI). The inclusion of this variable in this study is a novel approach to the determinants of life expectancy, especially in the context of Africa, where institutions are relatively poor compared to other regions of the world and where democratic norms have hardly been entrenched.

Corruption adversely affects both the health as well as the welfare of citizens (Maestad & Mwisongo, 2011). According to WHO and World Bank (2017), all five dimensions of health system performance are undermined by corruption, including equity, quality, responsiveness, efficiency and resilience. Jones and Jing (2011) and WHO (2018) reported that over US$500 billion, representing over 7% of healthcare expenditure is lost to corruption. Consequently, significant amount of public resources are lost globally which deny good and quality health to millions of people (Transparency International, 2006; Vian, 2008). In a study by Hanf et al. (2011) on 178 countries, it was estimated that more than 140,000 child deaths a year are attributable to corruption. The authors reported that national corruption levels had a stronger impact on child mortality rates than literacy, access to clean water, or vaccination rates, aside the potential adverse impact of corruption on access to clean water and sanitation, and overall public health expenditure levels. It is expected that corruption would have adverse effects on health outcomes.

Openness: This is used to capture the degree of globalization. Openness is expected to raise public awareness about economic, political and social affairs and help people take advantage of

trends around the world in order, among others, to raise their living standards and thus their health outcomes. Urbach, and Wills (2013) examined the effect of trade openness on health and found that free trade is associated with better health outcome particularly for lower income countries. Hudak (2014), in a study covering 30 low and high-income countries from 1960 to 2012 found that greater openness improves life expectancy. On a panel of 92 countries from 1970 to 2005, Bergh and Nilsson (2010) reported that globalization had positive strong impact on life expectancy.

Owen and Wu (2007) examined the relationship between trade openness and health outcomes on a panel of 139 countries. Increased trade openness was associated with lower infant mortality rates and higher life expectancies. The study reported that for rich countries, the association appeared to be blurred, in contrast to developing countries, where significant evidence was found. Levine and Rothman (2006) in a study covering 134 developed and developing countries reported that the impact of trade openness on infant mortality was negative and significant. A positive relationship was found between life expectancy and trade openness in a study by Herzer (2017) using panel data from 1960 to 2010 on 74 developed and developing countries. In addition, a negative relationship between infant mortality and trade openness was reported. In like manner, and on 42 Sub-Saharan African countries, Novignon, Atakorah and Djossou (2018) investigated the link between trade openness on three health outcomes, i.e. life expectancy rate, infant mortality rate, and under five mortality rate. It was found that improved trade integration resulted in better health outcomes. Specifically, it was reported that trade openness has a positive and significant effect on life expectancy, and a negative effect on infant mortality and under five mortality rates respectively.

Razmi (2012) found in a study on oil rich countries from 1980 and 2009 that there was a positive and significant relationship between trade openness and life expectancy while between trade openness and infant mortality, a significant indirect relationship existed. In a study on Pakistan, Alam et. al. (2016) investigated the impact of trade openness and foreign direct investment on life expectancy from 1972 to 2013. The findings indicated that trade openness and FDI were associated with increase in life expectancy. An important aspect of openness is the increasing use of ICT to which better health outcomes are linked. First, efficient management and prevention of diseases is aided by ICT (Haluza & Jungwirth, 2015), including enhancing health system performance and administration (Micevska, 2005), making consultations easier (Lee, Liu & Lio, 2016), facilitating effective communication between patient and provider, while reducing the knowledge gap (Lluch, 2011). However, some studies have found that globalization in the form of ICT adversely affects health outcomes. For instance, increased ICT usage is linked to less physical activity with its associated health implications (Booth et al., 2001), increased mental distress (Rosell et al., 2007), including irregular food intake (Kim et al., 2010)

Ethnic Fractionalization: As noted in the literature (see Campos & Kuzeyev, 2007) high ethnolinguistic fractionalization can potentially ignite conflicts, thereby leading to the diversion of public resources in their prosecution instead of to the provision of public goods. Consequently, increasing fractionalization or a move from homogeneity to heterogeneity can decrease the provision of infrastructure and worsen health outcomes. For example, Filmer and Pritchett (1997) reported that rather than public spending on health, the dominant driver of child mortality outcomes across countries are cultural factors (including ethnolinguistic fractionalization), income, income inequality, and female education. In the present study, data

are up to 2013 and not much different from year to year for majority of the sample countries. As such figures for the last 3 years were included to make up the data set for figures missing.

Urban population: This reflects the level of urbanization. The level of development is measured by urbanization which usually raises the population of the towns and cities due to migration of people seeking employment in industry and service sectors and moving away from agriculture. Geographical factors have been found to impact health outcomes (Baldacci et al., 2004)

Selck and Deckarm (2015) had argued that a major shortcoming in macro-quantitative studies on the determinants of life expectancy is the omission of improved sanitation on the average length of life, having found that sanitation increases the explained variance of life expectancy by as much as 11 percentage points, even after controlling for democracy, income, and other life expectancy factors. This variable was however not included in the present study due to non-availability of data on African countries.

The variables used and their sources are presented in table 1.

Table 1: Variables and their description

Variable	Definition	Source*
Life expectancy	Life expectancy at birth, total (years)	World Bank
Under-5 mortality	Mortality rate, under-5 (per 1,000 live births)	World Bank
Infant mortality	Mortality rate, infant (per 1,000 live births)	World Bank
Health expenditure	Health expenditure (as % of GDP)	World Bank
Income	GDP per capita, PPP (constant 2011 international $)	World Bank
C02	C02 emission per capita	World Bank
Corruption	Corruption Perception Index	Transparency International
Openness	Trade (% of GDP)	World Bank
Ethnic fractionalization	Historical Index of Ethnic Fractionalization	Drazanova (2019)
Urban population	Urban population (% of total population)	World Bank
Education	Mean years of school	World Bank

*Note: World Bank (2020); Transparency International (2020); www.politicalterrorscale.org (2020)

RESULTS AND DISCUSSION

The summary statistics are presented in appendix 2 and are not discussed due to space constraint. Table 2 presents the estimates of the baseline and extended models.

Table 2: Results of System GMM Estimations

Variable	Life expectancy		Under-5 mortality		Infant mortality	
	Baseline	Extended	Baseline	Extended	Baseline	Extended
Life expectancy (-1)	.9511178* (363.85)	1.000704* (161.79)		-		-
Under-5 mortality (-1)		-	.9433193* (262.43)	.9534586* (166.91)		-
Infant mortality (-1)		-		-	.939796* (319.39)	.9358809* (161.27)
Health expenditure	.2014866* (8.49)	.0093479** (2.52)	-.7489252* (-16.37)	-.0394309* (-3.91)	-.3924635* (-16.37)	-.0657789* (-9.89)
Income		.0000319* (4.23)		-.0001993* (-17.13)		-.0001043* (-8.27)
CO2		-.1498525* (-4.89)		.4101041* (5.19)		.5651111* (4.12)
Corruption		-.1375066* (-12.21)		.416793* (7.78)		.1895177* (7.27)
Openness		.0016765* (4.50)		-.006696* (-10.55)		-.0028249* (-6.84)
Ethnic fractionalization		1.675121* (2.85)		-.3015628 (-0.22)		.6962345*** (1.66)
Urban population		-.0315933* (-5.38)		.2323787* (9.25)		.0805073* (8.63)
Education		.0177091 (0.94)		-.8895007* (-5.74)		-.7249738* (-9.00)
Constant	2.301951* (10.11)	.9499112*** (1.85)	5.377479* (9.87)	-4.740238** (-2.12)	3.661162* (15.22)	1.222808 (1.45)
No of observations	784	584	784	584	784	584
Number of instruments	32	39	32	39	32	39
Number of groups	49	44	49	44	49	44
Wald (χ^2) statistic	137646.35 [0.0000]	200009.21 [0.0000]	86173.00 [0.0000]	272094.90 [0.0000]	102140.92 [0.0000]	202945.40 [0.0000]
Sargan's test of overidentifying restrictions (χ^2) Statistic	33.84112 [0.2451]	32.24485 [0.3092]	35.65783 [0.1837]	37.65212 [0.1303]	37.36686 [0.1371]	37.1349 [0.1428]

Note: *, ** and *** denote rejection of the null hypothesis at 1%, 5% and 10% level of significance respectively. Z/T-statistics are reported in brackets. P-values are in square brackets.
Source: Author's computations from estimation data

Health Expenditure: As shown in table 2, the coefficient of health expenditure is positively related to life expectancy and statistically significant at 1% and 5% level in both the baseline and extended models respectively. Thus, higher government expenditure (on health) will have an upward pull on life expectancy. A 10 percentage point rise in expenditure (as a percentage of

GDP) will lead to approximately 0.1 years increases in life expectancy. Consequently, a doubling of health expenditure will lead to about 1 year increase in life expectancy. In this context, health expenditure matters for life expectancy. The results also indicate that a 1-period lagged health outcomes have a significant upward pull on their respective current values. These results are consistent with previous findings by OECD (2017) linking increases in health expenditure to additional months of life expectancy. The results from the baseline model, in which the level of income is not included corroborates the findings by Jaba, Balan and Robu (2014) which indicates a positive relationship between health expenditure and life expectancy, despite variation in income levels. It reechoes a previous finding on SSA and MENA countries by Akinkugbe and Afeikhena (2006) which reported a significant positive effect of health care expenditure on life expectancy.

In line with Bokhari, Gai and Gottret (2006), the study maintains that government health expenditure spending is as important as economic growth in determining better health outcomes. However, it is also possible that the positive impact of health expenditures in Africa is effective in prolonging lifespan up to a certain threshold value, in line with the findings by Clemente and Pueyo (2014) on 29 OECD countries from 1960 to 2000. Generally, very few countries in Africa under the period of investigation had health expenditures of up to 8% in GDP. The implication is that improving current health expenditures in Africa are critical towards improving longevity in the continent. The results differ from those reported in Deshpande, Kumar and Ramaswami (2014) in which for developing countries, healthcare spending was not found to play a significant role in life expectancy.

A statistically significant negative impact is reported for under-5 mortality and infant mortality rates in both the baseline and extended models respectively. Thus, an increase in health expenditure leads to a fall in both under-5 and infant mortality rates. This is consistent with earlier findings by Gupta, Verhoeven and Tiongson (1999), and Wang (2002). The results differ (in terms of magnitude and significance) for under-5 and infant mortality rates from earlier investigations by Kim and Moody (1992), Musgrove (1996), and Filmer et al. (1999).

Income: The coefficient of real income has a direct relationship with life expectancy. The result is statistically significant at 1%, implying that improved real income is associated with higher life expectancy. On the other hand, a rise in real income reduces under-5 and infant mortality rates significantly. This is consistent with the finding linking infant mortality and children's health to family income and maternal education (Braveman et al., 2010). A rise in life expectancy due to income may be due to the latter's influence on various health outcomes through improved nutrition, access to water, housing, and sanitation and access to healthcare services.

The results indicate that the effect of income on health outcomes is generally weak. This is consistent with findings in the empirical literature (Ricci and Zachariadis, 2006; Anyanwu & Erhijakpor, 2007). The results are different from those reported in Casterline et al. (1989), Baldacci et al. (2004), Zakir and Wunnava (1999), and Pritchett and Summers (1996).

CO2 emission: The environmental quality indicator (Co2 emission) and life expectancy have an indirect relationship and statistically significant. Higher Co2 emission will lead to a decrease in life expectancy. Higher Co2 emission (unless controlled and mitigated) is expected to adversely affect human health and longevity. On the average, a unit change in Co2 emission is associated with reduced life expectancy by approximately 0.15 years (or 1.8 months). Consequently,

pollution is a significant predictor of life expectancy. Interestingly, Co2 emission is directly related to under-5 and infant mortality rates. A 10% increase in Co2 emission per capita reduces under-5 and infant mortality rates by about 4.1 and 5.7 reductions per 1,000 live births. This is consistent with past findings linking rising co2 emission to adverse health outcomes (Bell, Dominici and Samet 2005; Pope et al., 2009; Chen et al., 2013; Shobande, 2019; Rasoulinezhad, Taghizadeh-Hesary and Taghizadeh-Hesary, 2020).

Corruption: Corruption and life expectancy are inversely related. The result indicates that worsening life expectancy is associated with a rise in the level of corruption. The adverse impact of corruption on longevity is statistically significant at 1%. A rise in the CPI index by 1 unit reduces life expectancy by about 0.14 years (or 1.7 months). Under-5 and infant mortality rates are reduced when there is an increase in corruption. A unit rise in the corruption scale is associated with an increase of about 0.42 percentage point increase in under-5 mortality and 0.18 percentage point increase in infant mortality rates. The results are consistent with theoretical expectation, as corruption through diversion of public resources to private ends, reduces both the quantity and quality of aggregate spending in general and health expenditure (especially capital expenditure on health) in particular. The result suggests that the extent of corruption is significant when addressing the health outcomes in Africa. Thus, worsening cases of corruption are associated with poorer health outcomes. As pointed out by Vian (2008), the channels through which corruption can adversely have heath consequences include: building of health facilities including their rehabilitations, procurement of equipment and supplies, drug use and distribution, product quality regulation, medical research, provision of medical services, and education of health professionals.

Openness: The openness coefficient is directly related to life expectancy and statistically significant at 1%. The result is similar to those obtained in previous studies (Hudak, 2014; Bergh & Nilsson, 2010; Owen & Wu, 2007; Alam et. al., 2016; Herzer, 2017; Novignon, Atakorah and Atakorah). Additionally, openness has a negative relationship with both under-5 and infant mortality rates respectively, suggesting that improved openness is beneficial to under-5 and infant mortality rates. This is consistent with past empirical findings on the impact of openness on infant mortality (Razmi, 2012; Levine & Rothman, 2006; Herzer, 2017) and on under under-5 mortality (Novignon, Atakorah & Atakorah, 2018).

Ethnic fractionalization: Ethnic fractionalization has a statistically significant positive effect on life expectancy, and a statistically significant negative effect on infant mortality rates. Although it is positively associated with under-5 mortality, ethnic fractionalization is not a significant factor. The finding linking ethnic fractionalization to higher life expectancy is important and interesting for African countries, given that it suggests that longevity has less to do with ethnic diversity. Past investigations including Andersen and Newman (2005) implicated ethnic minority as responsible for poorer access to healthcare services compared to the majority of the population in the United States, but studies linking poorer access to healthcare due to ethnic fractionalization in Africa are largely unavailable. In terms of the coefficient of ethnic fractionalization as it affects infant mortality, the result supports the finding by Filmer and Pritchett (1997) which reported that the dominant driver of child mortality outcomes across countries are cultural factors (including ethnolinguistic fractionalization), although in this study the effect of income on infant mortality, though significant is less than that of ethnic

fractionalization. These results are plausible, given that Africa has been home to violent conflicts for several years. Importantly, the literature has reported adverse impacts of conflicts on average calorie consumption (Stewart and Huang, 2001), health (Bundervoet, Verwimp & Akresh, 2009), and on the determinants of health outcomes, including education and schooling (Akresh & de Walque, 2008). With half of the over 80% of conflicts occurring in low-income countries taking place in Africa (Stewart and Huang, 2001), in which both women and children die.

Urban Population: The results suggest that increased urbanization is associated with lower life expectancy. A 1% point increase in urban population reduces life expectancy by about 0.03 years (or 0.36 months). Furthermore, under-5 mortality and infant mortality rates are reduced significantly by an increase in urban population. A 10% rise in urban population is associated with about 2.3% and 0.8% fall in under-5 and infant mortality rates respectively.

Although urbanization is expected to improve health outcomes due to improvements in infrastructure resulting in increased access to health services, more educational opportunities, improved sanitation, and clean water, improve health outcomes (McDade & Adair, 2001; Eckert & Kohler, 2013), the evidence in this study does not support these arguments in the case of life expectancy. Several reasons may be responsible for this. Rural Africa with its inclement weather, less pollution, more cohesive family and social bonds, all lead to a less aggressive outlook on life, in contrast to the urban centres where there appears to be more encroachment on the natural environment, more completion for available resources and the like. Due to the more sedentary nature of urban life, whether or not the individual is employed, coupled with the consumption of processed food high in calories and low in nutrition, leading to a wide range of diseases including obesity and diabetes worldwide (Gracey, 2002), the tendency to have shorter lifespan due to urbanization is plausible.

A major problem in Africa is poverty. With urban life largely characterized by close proximity of people, crowding, intensified by poverty induces several families to live in the same little space, a situation that increases the contact with the air and surfaces that other people breathe and touch. Several diseases can be more easily transmitted where there is crowding including rheumatic heart disease (caused by the species of group A beta-hemolytic Streptococcus) (Longo-Mbenza et al., 1998), tuberculosis (Antunes & Waldman, 2001), and helminthic infections (Carneiro et al., 2002). According to Krieger and Higgins (2002), outcomes such as suicide, homicide, intentional injuries and mental illness are intensified by the stress of living with limited privacy in tight residences.

Additionally, both indoor and outdoor air pollution is more pronounced in urban areas, a major risk factor for contracting acute respiratory infections and responsible for the death of children between the ages of 1 and 5 in developing countries (Bruce et al., 2000). Added to this is the hazard in urban centres of motor vehicle traffic, and the associated noise and air pollution (Tapia Granados,1998), , including motor vehicular accidents, a leading cause of death globally (Odero et al., 1997; Crandall et al., 2002). With urbanization in the developing world comes a significant excess demand of water over and above what government authorities can supply. According to United Nations Environment Programme (2002), prices of water are not usually driven by market forces, leading to disincentive by individuals and industries for water conservation. Lack of a direct source and limited access in households to water increases the risks of gastrointestinal pathogens, louse-borne diseases and scabies (Carneiro et al., 2002;

Strickland et al., 2000). Given these factors, urbanization can be associated with reduced life expectancy.

Education: The coefficients of education indicate that a rise in mean school years raises life expectancy and reduce mortality rates for under-5 and infant mortality rates. An additional school year is associated with an increase in life expectancy by 0.02 years and a reduction in under-5 mortality by 0.89% and infant mortality by 0.72%. Thus, the more educated, the more likely that a person will live an additional year, reduce both under-5 and infant mortality rates of their children, ward or loved ones. The positive association between life expectancy and education may be due to educated persons being less likely to indulge in unhealthy behaviours including smoking, drinking, drug abuse and more likely to use safety measures such as seat belts and installation of smoke detectors in their residences, as discussed in Cutler and Lleras-Muney (2006) and Goldberg and Smith (2007). Additionally, educated persons have better access to health care (Van Doorslaer & Masseria, 2004), and experience lesser mortality rates (Mackenbach, 2006).

The diagnostic statistics are adequate. The Wald statistics indicate that all the variables are jointly significant in explaining the health outcomes in Africa. The validity of the instruments is evidenced by the Sargan's test, implying that the deployment of the system GMM technique on the data used in the study is appropriate.

CONCLUSIONS

The paper examined whether health expenditure matters for health outcomes (proxied by life expectancy, under-5 mortality rates and infant mortality rates) in Africa, towards an inclusive sustainable development for the continent. The period covered is 2000 through 2016 on 49 African countries and following the Arellano and Bover (1995) and Blundell and Bond (1998) approaches, the data was analyzed using the two-step system GMM.

In both the baseline and extended models, the findings indicate that health expenditure has a direct and significant impact on life expectancy, and a negative and significant impact on under-5 and infant mortality rates respectively. Thus, raising health expenditure will raise life expectancy and reduce both under-5 and infant mortality rates. In addition, real income, openness, ethnic fractionalization and education were found to be positively associated with life expectancy, while Co2 emission, corruption and urbanization exerted a negative effect. Whereas real income, openness, urbanization and education were found to reduce under-5 and infant mortality rates significantly, Co2 emission, corruption, increased them. Ethnic fractionalization was found to exert a significant negative effect on infant mortality rates, but not a significant factor affecting under-5 mortality rates.

There are policy implications with respect to inclusive sustainable development arising from the findings. First, prioritizing health and education expenditure increases is germane with a view to improving life expectancy, and reducing under-5 and infant mortality rates. Second, effective policies must be adopted and executed to raise income levels, in order to improve the citizens' capacity to better access and spend more on health goods and services. Third, policies that improve access to education and reduce pollution should be supported by governments at all levels, while strengthening the institutional environment to address corruption and stimulate inter-ethnic harmony.

The empirical findings necessitate actionable recommendations. In the first place, there is the need to improve health expenditure in Africa, as important stimulus to health outcomes. This can be accomplished through higher budgetary allocation to health. Second, improving real income is germane as a step towards enhancing health outcomes in Africa. Real income could be improved through policy framework that improves growth and production. In this context, raising nominal wages at the expense of increased production is not likely to be a prudent step at maximizing living standards and consequently on health outcomes. In addition, policies that enhance the quality of the environment are crucial if the goal of improved health outcomes in Africa is to be achieved. Efforts must be made to implement national policies on pollution (where such policies exist) and initiated and pursued vigorously (in countries where they are yet to be initiated). Specifically, laws prohibiting Co2 emissions above some environmentally damaging thresholds should be implemented, coupled with fiscal tools of taxes which discourage the use of technologies that tend to raise air, land and water pollutions. Furthermore, improved access to quality education is germane to enhanced productivity in Africa, given the imperative of education in the sustainable development literature. With better education comes greater likelihood to indulge in healthy behaviours, earn better incomes which have impact on longevity, while having a downward pull on mortality rates. Finally, the institutional environment should be improved in order to address corruption, given the significance of corruption in worsening health outcomes. In this regard, greater collaboration among African countries in terms of information and intelligence sharing is germane.

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APPENDIXES

APPENDIX 1: COUNTRIES USED IN THE STUDY

Nigeria, Ethiopia, Egypt, Democratic Republic of the Congo, South Africa, Tanzania, Kenya, Algeria, Uganda, Sudan, Morocco, Ghana, Mozambique, Cote d'Ivoire, Madagascar, Angola, Cameroon, Niger, Burkina Faso, Mali, Malawi, Zambia, Senegal, Chad, Guinea, Tunisia, Rwanda, Benin, Burundi, Togo, Libya, Sierra Leone, Central African Republic, Eritrea, Republic of the Congo, Liberia, Mauritania, Gabon, Namibia, Botswana, Lesotho, Equatorial Guinea, Gambia, Guinea-Bissau, Mauritius, Comoros, Cabo Verde, Sao Tome and Principe, Seychelles.

APPENDIX 2: SUMMARY STATISTICS

Variable	Obs	Mean	Std. Dev.	Min	Max
Life expectancy	833	58.98487	7.865796	38.702	76.078
Under-5 mortality rate	833	91.04466	46.27246	12.8	234
Infant mortality	833	59.72389	26.51816	11	142.4
Health expenditure	833	5.474491	2.302413	1.28231	20.4146
Income	833	5127.132	6460.464	545.689	40015.8
CO2 emission	833	1.206722	2.104457	.017276	10.0437
Corruption	693	3.075902	1.10369	0	6.5
Openness	788	74.08696	37.08373	19.1008	311.354
Ethnic fractionalization	748	.6280334	.2500687	.022	.889
Urban population	828	41.66412	17.23229	8.246	88.559
Education	817	4.623256	2.034789	1.1	10.2