Innovations

"Socioeconomic determinants of health outcomes in sub Saharan Africa" panel data analysis

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Abstract

Background: Poor health outcomes (low life expectancy and high mortality) in developing countries have always been a concern for both citizens and policy makers. Although many studies have focused on the economic drivers of health outcomes in developing countries,this is not thecase for important socioeconomic determinants. Therefore, this study investigated the effects of gross domestic product, general government health expenditure, political stability, and percentage of urban population, unemployment rate, and corruption control on health outcomes in sub-Sahara African (SSA) region. **Methods** : To achieve this, the study used panel data analysis by employing Fixed effect, ,Random Effects, panel corrected standard error as well as dynamic panel model covering 38 countries in the region from 2000 to 2017 . **Results**: The findings reveal that population health outcomes - as measured by infant and maternal mortalities rates are related negatively with gross domestic product, political stability, percentage of urban population, and corruption control, but directly associated with unemployment rate. For life expectancy at birth, gross domestic product, political stability, percentage of urban population, and corruption are positively predicted, while related inversely with higher unemployment rate.

Conclusions: The findings therefore suggest that for SSA countries to achieve better health outcomes (high longevity and low mortalities) should emphasis on increasing gross domestic product, and investing on political stability and corruption control .Again, greater attention should be on enhancing urbanization and reducing unemployment.

Keywords: Health outcomes, Panel Data Estimation, General method of moment ,panel corrected, standard error, random effect, fixed effect.

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Introduction

1.1 Background of the Study

According to the neoclassical growth model, improvements in human capital, such as education and health, have a long-term beneficial impact on per capita income. There are four mechanisms through which healthier individuals contribute to the economy: the first one is at the workplace, healthier individuals are more productive and thus generally earn a higher income. The second one healthier individual are able to retire later and take less sick leave due to overall good health and so they are able to work longer. The third reason, healthier individuals are more likely to invest in their own education and training which then enhances their productivity. And the last one healthier individual are likely to save and invest more with the expectation of a longer (Khanam, 2018).

Human capital is considered as important factor to achieve the desired economic growth and development in any country. The role of human capital is a backbone of one's country sustainable economic development. Thus, the attention given to higher government expenditure on human capital development is vital because of its impact on individuals' lifetime incomes. Since better health enhances the effective and sustained use of the knowledge and skills that individuals acquire through education, it can reduce the depreciation of education capital, and thus increases the favorable effect of education on growth. (Anyanwu & Erhijakpor, 2009)

The population in Africa suffers poor health as manifested in high mortality rates and low life expectancy. Some researches show that not only good economic growth rate achieve desired improvements in health outcomes rather other environmental and social factors should be considered. In line with this throughout the world income inequality has recently become an issue of serious concern(Rahman, 2015). African economy generally stagnated throughout the 1980s and early 1990s when compared to other developing countries in Asia and Latin America Poverty is a severe problem in Africa as a result of poor economic performance, with 45-50 percent of the Sub-Saharan population living in poverty(WB, 1997).

The US President, the Prime Minister of the United Kingdom, the Pope, and leaders of the International Monetary Fund, the United Nations, the World Bank, and the World Economic Forum have all called income one of the most pressing issues of our day, with several emphasizing its social implications. The two most serious issues, according to the 2011 World Economic Forum, are income disparity and corruption. (Anyanwu & Erhijakpor, 2009)

Since health is promoted or inhibited by many factors, it is better to consider what foods and exercise alternatives are available and affordable, and what educational, employment, and housing opportunities are attainable. Understanding total healthcare expenditures, comprised of both public and private healthcare expenditures, as share of total gross domestic product (GDP), is also an important issue for effective policy-making. Over the last decade, healthcare expenses have increased in most Sub Saharan African countries.(Bein et al., 2017)

Maintaining, increasing, and enhancing the health of human populations is now regarded one of the most important strategies for developing countries' long-term growth. Several characteristics, such as socioeconomic development level, education, culture, environment, health expenditures, urbanization, and life style, have been linked to overall health status in macro level studies.

Because high levels of corruption imply inadequate transparency, paying bribes to obtain contracts, jobs, or services by breaking the law and norms may result in public displeasure or even massive societal damage. Researchers have brought up the Romanian Collective nightclub fire of 2015, which killed 64 people and injured 147 more. This massive disaster sparked a massive anti-corruption movement in Romania, titled "Corruption Kills"(Azfar & Gurgur, 2008).

The level of institutional quality is another crucial determinant of health. The institutional quality affect health through control of corruption, protection of property rights, economic liberalization, political system, and rule of law, political stability and absence of violence and decentralization. Therefore, the relationship between institutional quality and health is often controversial and it is not a priori possible to say without risk of error which are the institutional dimensions that improve health in a particular context (Majeed, 2020).

Since health is an integral part of sustainable development, and any attempts for its improvement should always be the main development goal of a nation. It is critical for all countries to invest effectively in their

health-care systems. At the same time, ill health is considered as a huge financial burden, and it is the major cause of 50% of the growth differential between developed and developing countries(Mafizur, 2015).
(Majeed, 2020)Estimate the effectiveness of government health spending on health outcomes in developing economies while controlling for economic development. In comparison to their Asian and Western Hemisphere counterparts, they found that African economies are inefficient in providing health care. If income level has this much of an impact on health, governmental actions to improve income level should be seriously examined, as well as research attention is important. in addition In order to set policy measures it is better to focus on the relevance of economic and social capital as health determinants by analyzing various indicators.

Recent empirical literature has identified important predictors of population health outcomes, however it may be difficult to apply these findings universally in SSA nations because the majority of these studies are based on data from either industrialized or developing economies. (Such studies includes, (Gmel et al., 2016), (Bhattacharjee et al., 2014),(Nuviala et al., 2012) or pooled data from both emerging and developed nations (Kozek-langenecker et al., 2017). Meanwhile, studies on developing countries were very scanty (these few studies includes, (Viner et al., 2017), (Bichaka Fayissaa, 2014) One, the time period covered by this study is not very recent. Two, the study only used life expectancy (as indicator of health outcomes); however, very recent studies emphasized that infant and under-five mortalities could be very close to aggregate indicators of health outcomes (see the studies of (Liu et al., 2016),(El-kholy et al., 2016) .Very few previous studies have simultaneously analyzed the social and the economic indicators when addressing social determinants of health, Social structures and socioeconomic patterns are the major determinants of population health (Ahnquist et al., 2012).

However, since population health improvement requires action on multiple determinants, (Isham et al., 2013) this study will use factors that consider changes in how they invest in the health of the communities.

In comparison with earlier cross country studies, the main contributions of this study lie in using a panel data structure that allows us to control for country and time unobservable effects. In contrast to the cross-sectional single year datasets which were used in most previous studies this study has used a relatively larger sample size of countries compared to smaller sample sizes of many previous. Most of the previous studies were done in developed countries that is why this study focuses sub Saharan Africa countries. The model that is used in the panel data analysis has great effect on the result (Farag et al., 2013).

Paneldata offers certain advantages over crosssectional and timeseries analysis in that it compensates for o mitted variables, considers international differences, and enables more accurate inference of model parame ters due to more degrees of freedom and sample heterogeneity.In addition to that. This study used the two-step system Generalized Method of Moment (GMM) developed by (Areliano & Boverb, 1995). The rationale behind using of this model is due to its benefit in addressing the problem of endogeneity and collinearity of regressors.

The other most important point that this study going to add was that most studies like, (Chewe & Hangoma, 2020), focused on life expectancy and infant mortality rate as dependent variable but this study incorporates the other important dependent variable which is maternal mortality rate.

General Objective

The general objective of this research is to examine the effect of socio economic determinants factors on health outcomes for Sub Saharan African countries.In line with this the followings are specific objectives which have been addressed in this study.

- To identify the socioeconomic determinants of health outcomes in sub Saharan Africa
- To show the trend of health outcome in sub Saharan Africa for the study periods

- To show the trend of health outcome in Ethiopia for the study periods

Research Methodology

3.1 Data Sources and Type

A combination of two things must be done in order to construct an accurate and useful model. To begin, the model must incorporate a vast amount of data. Second, the model must include measures that best encompass the equation's variables. There are a variety of health indicators used to reflect health outcomes, ranging from life expectancy to newborn mortality rate. Finally, life expectancy, maternal mortality, and infant mortality are included in the model not because they are the best measurements, but because they are unquestionably the most readily available data measurements. The information were gathered from the World Bank dataset, the World Development Index, the World Health Organization, World governance indicator as well as other relevant national and international institutions. The researcher was used secondary data, which is a panel data from 2000 to 2017 for all selected thirty seven sub Saharan African countries, to conduct the study. Panel estimation is a useful model since it allows for the inclusion of many countries over a long period of time in order to obtain the finest statistical findings.

3.2 Model Specification

From the work of (Zweifel, 2012) citizens' health outcomes are exposed to various drivers. The study developed three models to identify the determinants of health outcomes by using three health outcome proxies as follows: $\boldsymbol{Hit} = \sum \beta X_{it} + \varepsilon_{it}$, where $\varepsilon_{it} = \mu_i + \lambda_t + \nu_{it}$.. (1) Where Y_{it}, and X_{it} represent the dependent variable, and a vector of values of additional explanatory variables(denotes vectors of determinants of health outcomes such as; gross domestic product , government health expenditure, political stability, unemployment ,percentage of urban population, corruption control.) respectively. μ_i indicates individual-specific effect, λ_t indicates time specific effect, and ν_{it} represents the disturbance term. i= 1..., N is cross-section and t= 1....., T is time periods.

Functionally, $\boldsymbol{Hit} = \boldsymbol{f}$ (GDP$\boldsymbol{it}$, ghealth $\boldsymbol{it}$, pstablity $\boldsymbol{it}$, uempt$\boldsymbol{it}$, coruption$\boldsymbol{it}$, upop$\boldsymbol{it}$, ,+ εit)(2) where the subscript i denotes sample nations in SSA region, and t the time periods the study covered (2000-2017).For the purpose of estimation, this study employed panel estimation techniques. As Baltagi (2008) noted panel technique often provides better understanding in this case. Thus, this study estimated a more restrictive pooled panel that assumes parameter homogeneity, and cross-section independence. However, severe biases can arise if observations are pooled because SSA nations are heterogeneous. Hence, as a standard approach in econometrics literature in estimating panel data model of various effects (fixed and random).

This study expressed equation the above as: $\boldsymbol{Hit} = \boldsymbol{\alpha o} + \boldsymbol{\beta}$1GDP$\boldsymbol{it} + \boldsymbol{\beta 2}$ ghealth $\boldsymbol{it} + \boldsymbol{\beta 3}$ pstablity $\boldsymbol{it} + \boldsymbol{\beta}$ uempt$\boldsymbol{it} + \boldsymbol{\beta}$ coruption$\boldsymbol{it} + \boldsymbol{\beta 6}$upop$\boldsymbol{it} + \boldsymbol{\mu i} + \boldsymbol{\nu it}$ (3) Where Hit is vector of population health outcomes. For Hi, the study relies on life expectancy total (LET), infant mortality rate (IMR), and maternal mortality rate (Mmrate). From the model, μ denotes the regional/country specific unobserved effects, while β1... β6 are coefficients of independent variables, and v the disturbance terms. The study also performed robustness checks using the Hausman's test to determine the best efficient estimator between FE and RE.

3.2.1 Model Specification of Dynamic panel model

In addition to fixed and random panel models the study's preceding chapter examined several literatures in order to better understand and gain a detailed understanding of the subject. After that, the researcher devised the two-step GMM models to estimate the research variables. The GMM model that develops three models to explain how socioeconomic factors influence health outcomes. To arrive at efficient results, the dynamic link between variables need sufficient information about prior time periods and a stronger ability to deal with variability in adjustment changes. The presence of a lagged dependent variable among the explanatories characterizes the dynamics in a model in econometrics (Pollock, 1992). In this scenario, it is uncommon for the conditional density of outcomes (Yit) conditional on particular variables (Xit) to be distributed independently and identically across individual I and across time t. It is usual to suppose that, in addition to the effects of observable Xit, there are unobserved individual effects to capture the impact of those omitted elements. The study developed three models to identify the determinants of health outcomes by using three health outcome proxies as follows:

$$Y_{it} = \alpha Y_{it-1} + \sum \beta X_{it} + \varepsilon_{it}, \text{ where } \varepsilon_{it} = \mu_i + \lambda_t + \nu_{it} \quad \text{.......}(1)$$

Where Y_{it}, Y_{it-1}, and X_{it} represent the dependent variable, the lagged dependent variable, and a vector of values of additional explanatory variables respectively. μ_i indicates individual-specific effect, λ_t indicates time specific effect, and ν_{it} represents the disturbance term. i= 1..., N is cross-section and t= 1, T is time periods.

From equation (1) the study developed the next equation which is specific to research objective

$$Yit = \gamma + \sum_{J=1}^{m} \alpha J Yi,\ t-j + \sum_{r=0}^{n} \beta\ r\ Xi,\ t-r + \mu i + \nu it \quad \text{.......}(2)$$

Where Y_{it} = Health status, $Y_{i,t-j}$= lagged Health status, $X_{i,t-r}$= vector of socio-economic determinants.

From this equation the study developed the following three econometric models to indicate the determinants of health status as follows:

Model I: Taking life expectancy as proxy for health outcomes

$lnLE\ it = \beta_1\ lnLE\ it\text{-}1 + \beta_2\ lnGDP\ i;t + \beta_3\ lnghealth\ it + \beta_4\ lnpstability\ it + \beta_5\ lncoruption\ it + \beta_6 ln_{puop} it + \beta_7\ lnuemptit + \varepsilon it$.......(3)

Model II: Taking Infant Mortality rate as proxy for health outcomes

$lnIM\ it = \beta_1 lnIM\ it\text{-}1 + \beta_2\ lnGDP\ it + \beta_3\ lnghealth\ it + \beta_4\ lnpstability\ it + \beta_5\ lncoruption\ it + \beta_6 ln_{puop} it + \beta_7 lnuemptit + \varepsilon it$.......(4)

Model III: Taking Maternal Death Rate as proxy for health outcomes

$lnMM\ it = \beta_1\ lnMM\ it\text{-}1 + \beta_2\ lnGDP\ it + \beta_3\ lnghealth\ it + \beta_4\ lnpstability\ it + \beta_5\ lncoruption\ it + \beta_6 ln_{puop} it + \beta_7 lnuemptit + \varepsilon it$.......(5)

Where

lnLE, lnIM and lnMM are natural logarithm of life expectancy, natural logarithm of infant mortality and natural logarithm of maternal Mortality rate respectively.

lnGDP =natural logarithm of gross domestic product per capital

lnghealth =natural logarithm of general government health expenditure

lnpstability= natural logarithm of political stability

lncoruption= natural logarithm of corruption control index

lnupop = natural logarithm of percentage of urban population

lnempt =natural logarithm of unemployment rate

4. Data Analysis and Discussion

To accomplish the major and specific objectives outlined in chapter one, we provide all of the study's statistical and econometric results, together with their interpretations and diagnostic tests.. The section will be divided into two parts. The normality test, correlation matrix, and graphical linkage of the variables in the health outcomes regression model are discussed in the first section. The panel unit root test, the panel co-integration test, and the Dynamic panel regression estimation result of the health outcomes equation have been briefly discussed in the second section, which is dedicated to analyzing the basic econometric results. Finally, in this chapter, we have reviewed the PCSE findings as well as the two-step GMM results of health outcomes regression models.

4.1. Descriptive Analysis

This chapter gives summary and presentation of statistical and results.

Table 1 Summary Statistics of the Variables Used for health outcomes model

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Variable	Mean	Std.devation	Min	Max	observation
Life expectancy overall between Within	57.24994	6.540053 5.508256	40.369 46.293	74.51463 73.09263	N=646 n=38 T=17
Immrate overall between Within	60.9818	22.76476 20.06365 11.21026	12.5 13.22353 31.79365	136.9 111.2941 106.9466	N=646 n=38 T=17
Mmrate overall between Within	550.834	313k.43 295.6069 114.1167	53 59.35294 153.1873	2250 1517.647 1283.187	N=646 n=38 T=17
Gdpoverall between within	2282.906	3181.415 3150.964 662.6586	194.8731 229.5228 4241.35	20532.95 15246.99 7568.869	N=646 n=38 T=17
Ghealthoverall Between Within	1.732173	1.088197 .9893633 .4791808	.1585202 .3826412 -.1754117	5.826442 4.347385 3.520366	N=646 n=38 T=17
pstably overall Between Within	-.5395137	.6582417	-1.826384	1.303456	N=646 n=38 T=17
corupt~n overall Between Within	-.5395137	.6582417 .6414551 1789536	-1.826384 -1.588668 -1.275293	1.303456 1.057366 .1051463	N=646 n=38 T=17
upop overall Between Within	37.70711	16.4861 16.4404 2.865241	8.461 10.45418 25.32887	88.976 84.71741 46.14287	N=646 n=38 T=17
uempt overall Between Within	8.120217	7.555613 7.534058 1.316551	.32 1.008235 3.594922	34.35 28.04882 14.47492	N=646 n=38 T=17

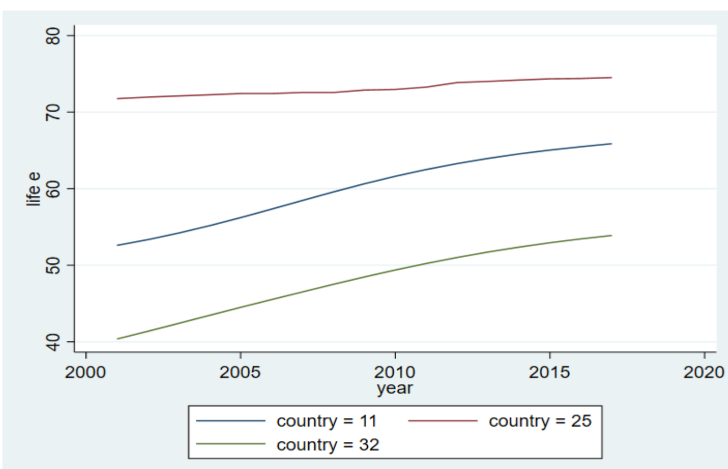
This description will focus on the three outcome variables (life expectancy, infant mortality and maternal mortality.) and three countries (Ethiopia, Mauritius and sierra Leone)the main reason why those countries selected for comparison is because of their health outcomes, Mauritius has good health outcome while Seri lone has poor health outcomes in addition the researcher is interested to present the health outcomes of our country Ethiopia by comparing with the higher and lower outcomes with in the selected sub-Saharan countries. As it can be shown in the above table the overall average life expectancy of 38 sub-Saharan African countries is 57.24 years with an overall deviation of 6.54 years. The minimum life expectancy is

40.36(Sierra Leone's) and the maximum is 74.5 (Mauritius's) indicating the huge gap that exists in life expectancy among the countries that are selected for analysis.

The gap can be attributed to different historical and economic regimes the countries have been under for the period between 2000 and 2017 and even before 2000. For instance, Sieraleone was in a civil war in the last decades of the twentieth century and the post-2000 period of reconstruction has been hugely influenced by this national rupture. It is no wonder that its life expectancy is found to be one of least among the countries selected for this analysis. However, Mauritius's higher life expectancy is attributed to its sustained development and richness in resources with small number of population. In terms of GNP, Mauritius has one of the highest GNP per capita in Africa. Coming to Ethiopia, its life expectancy is 59.99 which is a bit higher that the average Sub-Saharan African countries. Ethiopia's life expectancy has been on the rise since the mid-1990s, for the country has shown positive development in health-related investments and interventions.

Moreover, the overall average infant mortality rate in sub Saharan Africa is 60.9818 with 136.9 maximum (for Sieraleone) and minimum 12.5 (for Mauritius) while Ethiopia's is 58.84 which is a bit below the Sub-Saharan overall average (60.98). Historical developments exposed above and lack of investment and reasonable expenditure on health thereof have inhibited Sieraleone from registering improvement in curbing rising infant mortality rate. Mauritius, on the other hand, has made use of its stability and sustained economic growth to work toward reducing infant mortality rate and that is why the rate is the lowest in Sub-Saharan Africa. Coming to Ethiopia, as recognized by WHO and World Development Indicator, the country's infant mortality rate has shown a marked decline, for instance from 83.6 in 2001 to 39.5 in 2017 (as can be seen from Table 1). This marked decline has been attributed to the continuous and focused investment the country has made in the health sector.

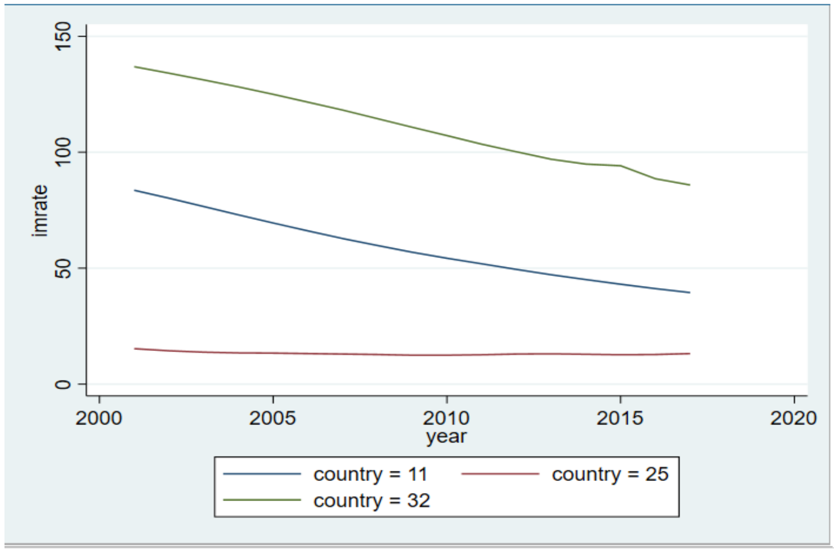
Figure 1 Comparison of Ethiopia life expectancy with Sierra Leone and Mauritius life expectancy



Where 11, 25, 33 represents life expectancy of Ethiopia, Mauritius and sierra Leone respectively.

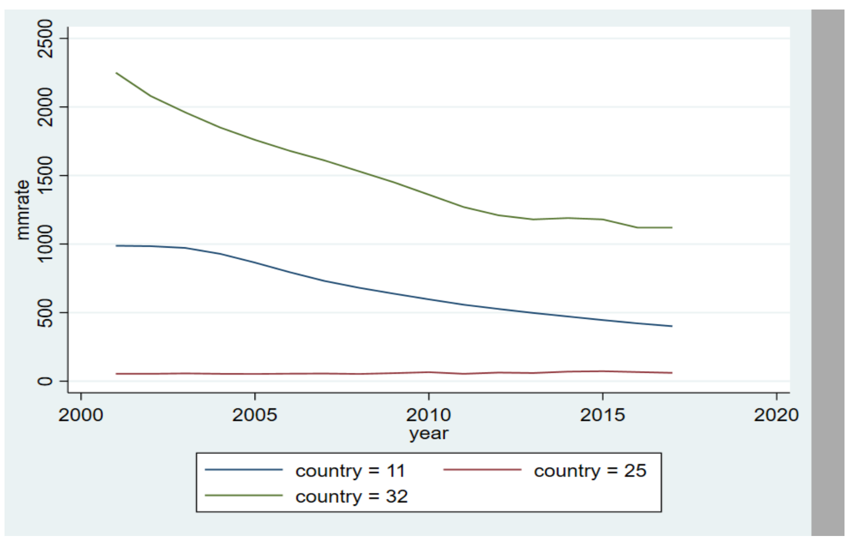
Source: author's computationFigure 1 depicts increasing life expectancy of Siera Leone, Mauritius and Ethiopia. It further confirms that Ethiopia and Sierra Leone's life expectancy is marked by upward trend while Mauritius's is characterized by a seemingly constant but a smooth increasing trend.

Figure 2 Comparison of Ethiopia infant mortality with sierra Leone and Mauritius infant mortality



Where 11Ethiopia =,25 Mauritius = 33=sierra Leone

Figure 3 Comparison of Ethiopia maternal mortality with Sierra Leone and Mauritius maternal mortality



4.2. Econometric Analysis of health outcomes model

4.2.1. Normality Test

The normality assumption also plays a crucial role in the validity of inference procedures, specification tests and forecasting. In the panel data literature, Blanchard and M´aty´as (1996) examine the consequences of non-normal error components for the performance of several tests. Montes-Rojas and SosaEscudero (2011) show that non-normalities severely affect the performance of the panel heteroskedasticity tests by Holly and Gardiol (2000). Despite these concerns the Gaussian framework is widely used for specification tests in the one-way error components model; see, for instance, the tests for spatial models in panel data by Baltagi et al(2007).Before we begin regression analysis, it is prudent to ensure that the data is normal. Because normality is a fundamental assumption in econometric models, Table 2 shows the result of the normality test using skewnesses and kurtosis. Before we begin regression analysis, it is prudent to ensure that the data is normal. Because normality is a fundamental assumption in econometric models, Table 2 shows the result of the normality test using skewnesses and kurtosis.

Table 2 Tests of Normality for Variables in life expectancy model

Skewness/Kurtosis tests for Normality

Skewness / kurtosis tests for Normality					
Variables	Obs	P(skewenss)	P(kurtosis)	Adjchi2(2)	Pro>chi2
Lifee	646	0.1193	0.9004	2.44	0.2947
Gdp	646	0.101	0.701	41.29	0.263
Ghealth	646	0.323	0.210	12.14	0.137
pstablity	646	0.732	0.690	25.20	0.154
kcoruption	646	0.825	0.5334	43.64	0.312
Uempt	646	0.234	0.613	19.15	0.321
Upop	646	0.083	0.3524	29.71	0.134

As it can be showed in the above table except life expectancy, the level of each explanatory variable were not normal but after we transformed it to the logarithmic transformation of all explanatory variables were found normal.

4.2.2. Estimation results for Panel Unit roots and Co-integration

To see if there is a long-term link between the variables, we must first check for the presence of a unit root test. The many forms of unit root tests, such as LLC, IPS, and hadri, can be used to accomplish this. Then, using other co-integration tests such as pedroni, kao, and westerlund, we'll see if there's a log run relationship between our variables.

4.2.3. Panel Unit Root Tests variables

Table 3 Different types of panel unit root tests

			Fisher-type		Levin- Lin Chu (LLC)	
			Statistics	P-Value	Statistics	P-Value
Life			15.3827	0.0000	-40.4146	0.0000
Gdp			D 17.0849	0.0000	-4.0505	0.0000
ghealth			D 40.9499	0.0000	-2.7314	0.0032
pstablity			5.3953	0.0000	-5.5679	0.0000

Coruption			4.9710	0.0000	-3.5467	0.0002
uempt			1.8361	0.0332	-3.1635	0.0008
Upop			28.8534	0.0000	-9.9408	0.0000

The table above shows the unit root tests that can able to show us the absence of unit roots. The assumptions for the above LLC and fisher type discussed with their corresponding p-value. The null hypothesis of Fisher-type unit-root test is all panels contain unit roots and the alternative Ha is At least one panel is stationary. Based on this hypothesis, all variables are stationary at level. However, domestic gross product and government health expenditure are stationary at first difference. In the second LLC test, the null hypothesis is Panels contain unit roots and the corresponding alternative hypothesis is Panels are stationary. As a result all p- values are less than 5% this means we can reject the null and accept the alternative which means panels are stationary.

Before we look at the results of economic regression, it's a smart option to see whether there's any correlation between the variables in the equation. Because, in accordance with (Gujarati, 2004). The coefficients cannot be determined with great precision when multicolinearity exists. We may check the normality and graphical association of variables with this.

We can see that the highest level of collinearity between variables is 0.624 when we look at the Correlation matrix among variables in the life expectancy model in Appendix A.2.

Even if this result shows that corruption and government health spending are not highly associated, we can see that the nonexistence of a correlation for the other variables.

Only the unemployment rate is adversely connected to life expectancy in terms of the sign of individual connection. Life expectancy is positively connected to urbanization GDP, political stability, and corruption control. This correlation matrix was used to determine the direction of causality, although it is preferable to utilize the variance inflation factor (vif) because it provides a more realistic multicolinearity feature. As can be seen in Appendix A.2 Vif must be smaller than 5 in order to be considered as free of multicolinearity. The value of vif equals 2.10, indicating that multicolinearity is not a concern.

After verifying for multicolinearity, the next step is to determine whether or not autocorrelation exists in our model. We can reject the null hypothesis Ho: no first order autocorrelation since our model exhibits first order autocorrelation when we use the Wooldridge test for autocorrelation in panel data and get a p-value of 0.00. We recognize that the problem of autocorrelation, hetrosedaciticty, and hence we cannot utilize a standard list square in our model. But, because we don't trust this strategy, we merely ignore this model and move on to fixing fixed or random effects with some correction.

4.2.4 Random and Fixed Effect Regression Model Result

By enabling each variable to have its own intercept value, the Fixed Effect Model allows for heterogeneity or individuality between the two variables. Although the intercept may differ among variables, the phrase "fixed effect" refers to the fact that the intercept does not change over time. That is, it is time invariant, whereas the Random Effect Model states that the variables' intercepts share a common mean value. The Hausman Test must then be used to determine which model (fixed effect or random effect) is acceptable.

When we use FE, we anticipate that something about the individual will influence or bias the Predictor or outcome variables, and we must account for this. The assumption of a correlation between the entity's error term and predictor factors is based on this logic. We can analyze the net effect of the predictors on the outcome variable using FE because it removes the effect of those time-invariant traits. Another key premise of the FE model is that those time-invariant features are unique to the individual and should not be associated with other personal attributes.

Table 4 the impact of socioeconomic factors on life expectancy: fixed Effect Regression Model Result

Lifee	coef.	Std. Err.	T	P>|t|	(95% conf. Interval)
Gdp	-.0000984	.0001629	-0.60	0.287	-.0004184 .0002216
ghealth	-.0759617	.2084955	-0.36	0.883	-.4854286 .3335051
pstability	1.003117	.2881644	3.48	0.060	.4371876 1.569047
coruption	2.862498	.5796747	4.94	0.000	1.724068 4.000929
Upop	.9288365	.0376264	24.69	0.000	.8549416 1.002731
Uempt	-.3079281	.076557	-4.02	0.000	-.4582793 -.1575769
Cons	27.05465	1.550797	17.45	0.000	24.00902 30.10028

Table 5 The impact of socioeconomic factors on infant mortality :fixed Effect Regression Model Result

Imrate	coef.	Std. Err.	Z	P > (z)	(95% conf. Interval)
Gdp	.0010307	.0005492	1.88	0.061	-.0000478 .0021093
Ghealth	1.459824	.7031648	2.08	0.038	.0788701 2.840778
pstability	-4.165563	.9659817	-4.31	0.007	-6.062667 -2.26846
coruption	-8.28976	1.957014	-4.24	0.000	-12.13316 -4.446357
Upop	-2.760868	.1268527	-21.76	0.000	-3.009996 -2.511741
Uempt	-.2081993	.2580361	-0.81	0.420	-.7149597 .2985611
Cons	155.6473	5.230537	29.76	0.000	145.3749 165.9196

Table 6 The impact of socioeconomic factors on maternal mortality :fixed Effect Regression Model Result

mmrate	coef.	Std. Err.	Z	P > (z)	(95% conf. Interval)
Gdp	.0063719	.0062324	1.02	0.307	-.0058681 .0186118
Ghealth	25.13824	7.979672	3.15	0.002	9.46686 40.80961
Pstablity	-57.17851	10.96218	-5.22	0.000	-78.70727 -35.64976
Coruption	-75.92332	22.20863	-3.42	0.001	-119.5391 -32.30752

Upop	-22.95517	1.439553	-15.95	0.000	-25.78233 -20.12802
Uempt	-2.153463	2.928252	-0.74	0.462	-7.904294 3.597367
Cons	1310.472	59.3573	22.08	0.000	1193.9 1427.045

The essential point here is determining which model of estimation is acceptable after implementing the proper command and storing it. We will use the hausman test to determine whether fixed or random effect estimation is appropriate. Ho: estimation of the random effect is appropriate, while Ha: estimation of the fixed effect is appropriate.

Table 7 Hausman test result of health outcomes model

Model	chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)	Prob>chi2
life expectancy	390.00	0.0000
infant mortality	316.62	0.0000
maternal mortality	60.09	0.0000

Table 6 shows that using the result of fixed effect estimation since p-value of chi2 is 0.000 which is less than 5%, we must reject the null hypothesis and accept the alternative hypothesis. This conclusion implies that the fixed effect model an appropriate for analysis purposes.

4.2.5. Diagnostic tests

In this sub section we are going to discuss different tests of fixed effect model and their remedies measure.

Table 8 Test of multicolinearity

Variables	Vif	1/vif	
Gdp	2.51	0.389	
Ghealth	2.27	0.440	
Pstablity	2.18	0.458	
Corruption	1.91	0.524	
Upop	1.89	0.528	
Uempt	1.84	0.542	
Mean vif	2.10		

As it can be showed in table above the result of multi-collinearty test is by far less than 10 which makes us confident to say there is no multicolinearity problem.

Table 9 Test of autocorrelation for outcomes model

Model	F(1, 37)	Prob > F
Life Expectancy	141.186	0.0000
Infant Mortality	219.881	0.0000
Maternal Mortality	198.545	0.0000

As it present in the above table our Wooldridge test for autocorrelation in panel data prove that as we can reject the null hypothesis which is Ho: no first order autocorrelation means our model has first order autocorrelation.

Table 10 Test of cross-sectional dependence for outcomes model

Model	Average absolute value of the off-diagonal elements	Pesaran's test of cross sectional independence = 18.003,
Life Expectancy	0.628	0.0000
Infant Mortality	0.755	0.0000
Maternal Mortality	0.602	0.0000

As our result in table xx implies that our model has cross-sectional dependence, since probability value less than 5% So we fail to reject the null hypothesis which means there is cross-sectional dependence.

Table 11 Test of heteroskedasticity for outcomes model

Model	Wald test chi2 (38)	Pesaran's test of cross sectional independence = 18.003,
Life Expectancy	32288.59	0.0000
Infant Mortality	49399.75	0.0000
Maternal Mortality	68739.72	0.0000

In the above table our Modified Wald test for GroupWise heteroskedasticity in fixed effect regression model implies that our model suffers from group wise heteroskedasticity. Because at p-value of 0.000 we can reject the null hypothesis which is Ho: Panel Homoscedasticity.

There are three problems in this model first there is first order autocorrelation 2nd there is also group wise heteroskedasticity and we have also informed that the presence of cross-sectional dependence as a result we cannot use this model and rather we required to use Feasible generalized list square(FGLS)/ panel corrected standard error (PCSE) according to xx FGLS is better when the number of time series is greater than the number of cross-section but in our case we have 38 countries and 17 year so we are required to use PCSE. Which used us to consider everything.

Table 12 socioeconomic determinants of life expectancy panel corrected standard error (PCSE) Model Result

Lifee	coef.	Std. Err.	Z	P > (z)	(95% conf. Interval)
Gdp	.0003196	.0000333	9.59	0.000	.0002543 .000385
Ghealth	-.1665529	.2183326	-0.76	0.446	-.5944769 .2613711
Pstablity	0.9229681	.2408312	-3.83	0.000	-1.394989 -.4509476
Corruption	5.376967	.3248048	16.55	0.000	4.740361 6.013573
Upop	.1471393	.0133962	10.98	0.000	.1208832 .1733953

Uempt	-.4584589	.0248561	-18.44	0.000	-.507176 -.4097418
Cons	57.49097	.9348982	61.49	0.000	55.65861 59.32334

Table 13 socioeconomic determinants of infant mortality: panel corrected standard error (PCSE) Model Result

Immrate	coef.	Std. Err.	Z	P > (z)	(95% conf. Interval)
Gdp	-.0006742	.0004592	-1.47	0.142	-.0015742 .0002259
Ghealth	-.5417284	.4320111	-1.25	0.210	-1.388454 .3049978
Pstablity	-1.094878	.3998372	-2.74	0.006	-1.878545 -.3112117
Coruption	-4.135486	1.208785	-3.42	0.001	-6.504661 -1.766311
Upop	-.436666	.131513	-3.32	0.001	-.6944267 -.1789053
Uempt	-.1277164	.1543754	-0.83	0.408	-.4302867 .1748538
Cons	79.68731	8.485296	9.39	0.000	63.05644 96.31818

Table 14 socioeconomic determinants of maternal mortality: panel corrected standard error (PCSE) Model Result

Mmrate	coef.	Std. Err.	Z	P > (z)	(95% conf. Interval)
Gdp	-.0183744	.0044218	-4.16	0.000	-.0270409 -.0097079
Ghealth	-3.533575	4.631989	-0.76	0.446	-12.61211 5.544956
Pstablity	-22.28752	6.421547	-3.47	0.001	-34.87352 -9.701519
Corruption	-43.75199	13.02991	-3.36	0.001	-69.29015 -18.21383
Upop	-4.676096	1.133685	-4.12	0.000	-6.898078 -2.454114
Uempt	-2.810701	1.399447	-2.01	0.045	-5.553567 -.0678345
Cons	775.7962	76.02617	10.20	0.000	626.7876 924.8048

4.2.6 Regression Results of Dynamic Panel Model

Among the important features GMM the first one is it works to eliminate serial correlation and hetroskedasity and also used to cover endogenetiy problem.it can be used for time series, panel and cross-section data.it is efficient when we have greater number of cross-section than time series dimension .A reasons why researcher used two step GMM are first it is the augmented two step difference GMM second more robust to one step system GMM and the last it is more efficient and robust to heteroskedasticity and autocorrelation (roodman,2009)

Table 15 socioeconomic determinants of life expectancy: Dynamic panel-data estimation, two-step system GMM Model Result

Lnlifee	coef.	Std. Err.	Z	P > (z)	(95% conf. Interval)
L1	1.091076	.1474386	7.40	0.000	.7923372 1.389815
lngdp	.0326665	.0174967	1.87	0.070	-.0027851 - .0681181
lnghealth	.0048383	.0117126	0.41	0.002	-.0188936 - .0285703

Pstablity	.0043347	.010293	0.42	0.676	-.0165208 .0251902
coruption	-.0017097	.0212522	-0.08	0.936	-.0447708 .0413515
lnupop	-.1210387	.0652961	-1.85	0.072	-.2533412 .0112639
lnuempt	-.0038529	.0199824	-0.19	0.0048	-.044341 .0366352
Year	-.000291	.0017087	-0.17	0.866	-.0037531 .0031711
_cons |	.4300626	2.903875	0.15	0.883	-5.453746 6.313871

Table 16 socioeconomic determinants of infant mortality : Dynamic panel-data estimation, two-step system GMM Model Result

Immrate	coef.	Std. Err.	Z	P > (z)	(95% conf. Interval)
Gdp	-.0006742	.0004592	-1.47	0.142	-.0015742 .0002259
Ghealth	-.5417284	.4320111	-1.25	0.210	-1.388454 .3049978
Pstablity	-1.094878	.3998372	-2.74	0.006	-1.878545 -.3112117
Corruption	-4.135486	1.208785	-3.42	0.001	-6.504661 -1.766311
Upop	-.436666	.131513	-3.32	0.001	-.6944267 -.1789053
Uempt	-.1277164	.1543754	-0.83	0.408	-.4302867 .1748538
Cons	79.68731	8.485296	9.39	0.000	63.05644 96.31818

Table 17 socioeconomic determinants of maternal mortality: Dynamic panel-data estimation, two-step system GMM Model Result

lnmmrate	coef.	Std. Err.	Z	P > (z)	(95% conf. Interval)
Lnmmrate L1.	-.0560446	.0062344	-8.99	0.000	-.069261 -.0428283
lngdp	-.3434851	.0080612	-42.61	0.000	-.3605741 -.3263961
lnghealth	-.0817231	.0385392	-2.12	0.050	-.1634225 -.0000237
pstablity	-.1175773	.0116637	-10.08	0.001	-.1423034 -.0928513
coruption	-.3138676	.0399415	-7.86	0.000	-.3985397 -.2291955
lnupop	.0215552	.0178933	1.20	0.246	-.016377 .0594873
lnuempt	.1243133	.0111903	11.11	0.000	.1005909 .1480356
year	.0042034	. 0000459	91.57	0.000	.0041061 .0043008

4.2.6 Post estimation Tests Of Two Step System GMM Model

In this section we are going to present the necessary tests associated with two step system GMM method. These include autocorrelation and instrument validity tests.

Table 21 Autocorrelation Test for 2 Step SGMM Estimation

Table 21 Autocorrelation Test for 2 Step SGMM Estimation

Model	Pr > z (AR1)	Pr > z (AR2)
life expectancy (AR1,AR2)	0.992	0.541
infant mortality(AR1,AR2)	0.258	0.168
maternal mortality(AR1,AR2)	0.228	0.467

table 21 implied that our two step system GMM free from first and second order autocorrelation problem Statistically speaking you are correct we cannot reject the null-hypothesis at 5%.

Table 22 Sargan and Hansen Validity Test For 2 Step SGMM Estimation

Model	sargan test	Hansen test
	Prob > chi2	Prob > chi2
life expectancy (AR1,AR2)	0.987	0.986
infant mortality(AR1,AR2)	0.931	0.876
maternal mortality(AR1,AR2)	0.347	0.792

From table 22 above according to sargan and Hansen instrument validity test our instruments are valid. Sargan test has a null hypothesis (Ho: over identifying restrictions are valid the null hypothesis of the test implies all instruments are valid p value greater than 5% (0.05) implies, we accept the Ho, that is all instruments are valid .Sargan p-value must not be less < 5%. The higher the p-value of the sargan statistic the better According to Roodman (2006). So, for our case the above results with p-values indicate the group of instruments used in the analysis are valid.

Result interpretation and discussion

From our PCSE model regression result we find , GDP has significant impact on expected life outcome as our result revealed other things remain constant 1 unit increase in real GDP leads to on average of 0.0031year increase in life expectancy under the period taken to account in sub Saharan Africa. Keeping other factors constant, When GDP increase by 1 unit infant mortality decrease by -.0006742 similarly maternal mortality decrease by -0.0183744. Moussa Keita, 2013obtained a similar estimation outcome similarly (Kavitha.S.V,2017) has found negative relationship between gdp and maternal mortality.by analyzing panel data collected from countries observed every 10 years, from 1960 to 1990. Bloom et al. (2004) find the correlation between health and economic growth to be statistically significant and positive.

As our finding implies the impact of government health expenditure on the three health outcomes is insignificant it is may be due to For the following reasons, a theoretical link between health systems, which is commonly proxied by government health spending, and health outcomes is complex. First, if there is a functional private health-care market, a rise in government health-care spending may "crowd out" private health-care expenditures, i.e., when the government increases health-care spending, households transfer their resources to other purposes. Second, public resources may be inefficiently utilized. In underdeveloped countries, for example, doctors and nurses frequently fail to show up for work at health institutions, equipment sits idle due to a lack of critical parts, and pharmaceuticals funded by the central government are not distributed to patients in need (Lewis, 2006). Third, even if government funding is used wisely, supporting services such as water, sanitation, transportation, and communication infrastructure may be absent or inadequate, resulting in little or no improvement to people's health.

by contrasting with our result Williams, Atun and their friends have shown that an annual 1% reduction in government healthcare spending is associated with statistically and clinically significant increases in maternal mortality in the EU(Maruthappu et al., 2015).

The estimated coefficient for the political stability is found to have a high and statistically significant effect on life expectancy for the sample SSA countries under the period take into consideration When Political stability index increase in 1 unit means when it changed from unstable condition to more stable condition other things remain constant life expectancy increase by 0.922 and infant mortality decrease by -1.094878 as the same time maternal mortality decrease by -22.28752 stern and his colleagues also found inverse association between political stability and neonatal mortality (r ¼ -0.55).(Stern et al., 2003)

Improvements in life expectancy between 6 and 9 months are associated with agricultural production, political stability, access to clean water and sanitation, good governance, and primary school enrolment.

From our corruption control case we find that on average when corruption control index increase by 1 unit countries 'life expectancy increase by 5.376967year but infant mortality decrease by -4.135486 in the same manner maternal mortality decrease by -43.75199 at 1%statistical significant level. Hanf et al. (2011) examine the relationship between corruption and child mortality across a one-year period on a global scale. Their findings suggest that corruption may account for 1.6 percent of global child mortality, although they express concern that the model may understate the effect.

Witvliet et al. (2013) use survey data to assess the effect of corruption on the general health of adults in 20 African nations, in relation to age, sex, and socioeconomic position, in a paper that is comparable to ours. In all groups, they discovered a link between poor health and corruption.

This may due to Projects aiming at improving general health may have a reduced impact if corrupt officials steal from the health fund. If bribes are paid in the public health sector, the poorest members of the population may be denied access to inexpensive health care, which has a negative impact on the country's public health by making the service less effective (Savedoff & Hussmann, 2006). The wealthy benefit through corrupted systems, while the poor are exploited (You & Khagram, 2004).

When the percentage of urban population increases by 1 percent unit life expectancy increase by 0.147years while infant and maternal mortality decrease by -0.436666 and -4.676096 respectively. Other things remain constant when unemployment increases by 1 percent life expectancy decreases by 0. 458years. while unemployment has not significant impact on Infant mortality. According to Fred C. Pampel, Jr The mortality rate is affected more by urbanization, hospital beds, public welfare spending, and ethnic variety. similarly 103Fred C. Pampel, Jr found a result which implies reduce infant mortality-the former primarily through neonatal mortality .These findings imply that rural areas disadvantage in infant survival when compared to more urbanized areas.

When unemployment increase by 1 percent maternal mortality also increase by 2.810701.our result is supported by Singh & Siahpush, Life expectancy was inversely related to unemployment levels in all time periods similar to us (Singh & Siahpush, 2016) found areas with high unemployment rates had a lower life expectancy . According to Life expectancy varied substantially by time period, sex, and unemployment level, ranging from 69.5 years for men in high unemployment areas in 1990–1992 to 82.7 years for women in low unemployment areas in 2010(Singh & Siahpush, 2016).Two mechanisms were forwarded by Pekka to explain un employment is cause for higher mortality and lower life expectancy excess mortality. (1) *Causal effects of unemployment*: Becoming jobless and prolonged redundancy have negative effects on health and increase the risk of premature death. The causal effects of unemployment are mainly assumed to be mediated through increased psychosocial stress, tobacco and alcohol consumption, as well as loss of income and material deprivation.

(2) *Selection*: Persons likely to become unemployed, or to have difficulty in re-employment, have *pre-existing* ill-health and/or "lifestyle" (e.g. tobacco and alcohol consumption, diet), socioeconomic (e.g. social class, housing tenure) or personal characteristics (e.g. age, sex, physical weakness, psychological characteristics, and early life experiences) that increase the risk of future ill-health and mortality.

Conclusion

This paper scrutinized the impact of socioeconomic factors and health system components on child health outcomes by applying estimation methods which treat with the endogenous nature of those variables. The researcher used fixed panel by employing Hausman test, panel corrected standard error test and system GMM to estimate the determinants of health outcomes with a cross-country panel dataset from 38 sub-Saharan countries from 2000 to 2017. The findings imply that enhanced life expectancy in these countries is dependent on GDP, political stability, the percentage of urban population, and corruption control. Furthermore, GDP, political stability, percentage of urban population, and corruption control are all important factors in lowering newborn and maternal death rates in these countries. In this and earlier research, one of the key factors of LE was urbanization. It has long been believed that people living in urban areas have greater access to hospital treatment options and health information. General government health expenditure was expected to have a favorable impact on health status in the current study; however, this was not confirmed, and the data revealed no significant association between general government health expenditure and health outcomes. The results presented in this study indicate a continuous decline in infant and maternal mortality in a majority of countries in sub-Saharan Africa over the past two decades. On the other hand with the selected sub-Saharan countries life expectancy has an increasing trend for the previous 17 years. A large part of this improvement can be explained by coverage ofselected maternal, newborn, and child health interventions and other relative improvements in social and economic factors like, annual per capita income, effective governance and urbanization in sub-Saharan Africa.

The study's key finding is that economic stabilization initiatives, such as raising productivity, economic growth, and lowering unemployment, have a significant impact on s the region's health results.

Recommendations

To improve population health outcomes, the findings call for effective policies to reduce unemployment, increase GDP, promote political stability, and control the occurrence of corruption. As a result, policymakers must implement policies that will help to reduce the country's growing unemployment rate. It implies that lowering the unemployment rate can enhance the health of many people in the country. finally the author want to say state sponsored researches should be investigate in sub Saharan region in order to find different determinants of health outcomes in the region government and nongovernmental organizations and also scholars should give great attention for SSA region.

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