Macroeconomic Implications of Low Life Expectancy in Sub-Saharan Africa Nations: A Panel Technique Approach

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Abstract: This paper concerned with the understanding of major determinants of life expectancy in selected Sub-Saharan Africa (SSA) countries (Angola, Cameroon, Chad, Cote d'Ivoire, Equatorial Guinea, Gabon, Nigeria and Congo Republic) for the period of 2000–2015. The study found that improved water supply and its quality; sanitation, access to toilet facilities and clean environment; and improving the living standard and citizens' ability to meet basic needs are all positive and statistically significant to higher life expectancy at birth of citizens in these nations. These empirical findings therefore call for effective policy to be directed at providing water and sanitation facilities, and reducing pollution to improve longevity in SSA countries so as to enhance her regional economic productivities.

Keywords: Life Expectancy, SSA, Panel Estimation

1. Introduction

Life Expectancy refers to the average number of years a newborn is expected to live *if* mortality patterns at the time of its birth remains constant in the future [1]. It is the average-period that a person may expect to live, and the reflection of overall mortality level of a population. It also summarizes the mortality pattern that prevails across all age groups – children, and adults [2] and [3]. Life expectancy is the measure of the length of life expected for individual to be lived by at birth. Most often, life expectancy is frequently utilized and analyzed in the composition of demographic data for the countries of the world, for the attainment of mortality experiences and for more reliable international comparisons [4]. As [5] observed, life expectancy has important implications for the individuals and aggregate human behavior. In another words, it could predict labour force participation, economic growth, human capital investment, intergeneration transfers and incentives for pension benefits.
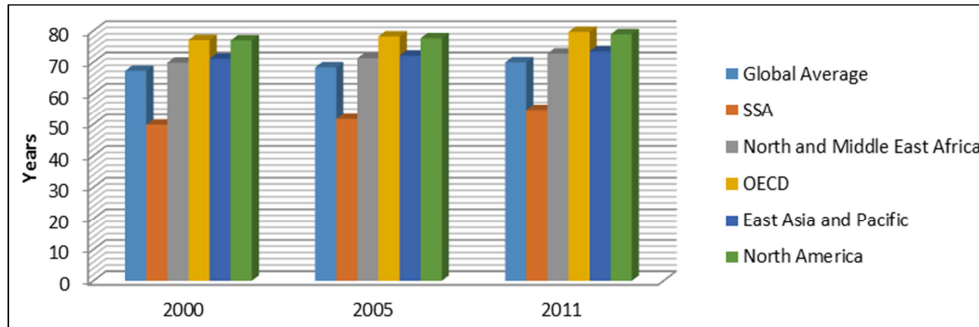
Often, the average life expectancy at birth is the most widely used indicator of population health status with several advantages over other measures of health outcomes/indicators. First, average life expectancy of citizens depends on both infant and other mortality rates, thus incorporating mortality rates at all stages in life. Second, it is not biased by age structure; and thirdly, data on life expectancy at birth are available for a reasonably large number of countries and time periods. This therefore suggest that the understanding of the major drivers of life expectancy is so crucial to developing countries (such as the case of SSA nations), who are earnestly striving for achieving socio-economic progress through investing significantly in social sectors like health, education, sanitation, environmental management and sustainability, and social safety nets [6] and [3]. Again in Sub-Saharan Africa (SSA) countries, variations in morbidity and mortality have been associated with a wide variety of measures of socio-economic status including per capita GDP, fertility rate, adult illiteracy rate, per capita calorie intake, health care expenditure, access to portable drinking water, urban inhabitants, unemployment rate and the nominal exchange rate.

However, SSA region experiences lowest life expectancy at birth compared to other regions over the past three decades. In fact, the average life expectancy at birth for SSA countries was merely 58-year-old, compared to 73 and 75 for the Middle East and North Africa (MENA), and East Asia and the Pacific (EAP) regions respectively in year 2015 [1]. Figure 1 below also shows the statistics of the average life expectancy at birth (LE) across various regions in the world. The statistics indicates that SSA region performs relatively

poorly against all other regions of the world. For instance, the average LE in SSA region increased slightly from about 50 years in 2000 to about 55 years in 2011. As [7] noted,

females in SSA countries often have longer life expectancy relative to males, although this situation also prevails in other regions of the world.

Source: Author's compilation from World Development Indicator dataset.

Figure 1. *Average Life Expectancy at birth (total) across Regions of the World.*

In this regard, a better understanding of the major determinants of life expectancy in SSA region will be very vital for policy-making process, especially those that are related to achieve the United Nation's Sustainable Development Goals (SDG) before year 2030. For instance, SDG three seek to achieve healthy households and promote well-being of citizens at all ages. Therefore, for appropriate policy implementation the research questions of this study is: What are the major determinants of life expectancy in SSA countries? An understanding of these issues can help policy makers in improving the welfare of citizens and making appropriate health policies for citizens. Hence, the section is organized as follows: section two was on research method, section three was on the empirical findings, section four focused on discussion and section five presented the conclusion and lessons for policy.

2. Methods

2.1. Existing State of Knowledge

The existing state of knowledge does not warrant any clear-cut generalization as to the effort of high life expectancy on economic development in today's less developed countries. Some theoretical analysis argue that high life expectancy creates pressures on limited natural resources, reduces private and public capital formation, and diverts additions to capital resources to maintaining rather than increasing the stock of capital per worker. Others point to positive effects such as economic productivities, savings and investment [3], [4], and [8].

The literature on the important of life expectancy has been approached from two perspectives. First, the effects of the longevity on economic output, and second, those major factors determining life expectancy. Moreover, the empirical evidence is split and the results do not depend on the methodology used. The methodology includes quantile regression, vector auto-regression (VAR), and panel data techniques. For example, in a large amount of data consisting of 148 countries for the years 1970 to 2010, [3] analyzed the

context of the life expectancy and economic productivities relationship. Augmenting their results with the quantile regression approach, which is sensitive to health differences between countries, indicates that the poorest countries' income gradient is still much larger than that of rich countries.

[9] examines how a large positive shock to life expectancy influenced the formation of human capital within countries during the second half of the 20th century. The results establish that the rise in life expectancy was behind a significant part of the increase in human capital over this period. According to the baseline estimate, for one additional year of life expectancy, years of schooling increase by 0.17 year. The evidence also suggests that declines in pneumonia mortality are the underlying cause of this finding, indicating that improved childhood health increases human capital investments.

Furthermore, [10] estimates the causal effect of life expectancy on per capita income and tests the hypothesis of a non-monotonic effect using finite mixture models. But the study of [11] concerned with understanding the factors of life expectancy in Turkey for the period 1965–2005. The determinants of life expectancy in Turkey are related to selected social, economic and environmental factors. Bounds testing approach to co-integration is employed to compute the long-run elasticities of longevity with respect to the selected economic, social and environmental factors. Empirical results suggest that nutrition and food availability along with health expenditures are the main positive factors for improving longevity whereas smoking seems to be the main cause for mortality. In contrary, [12] shows that improvements in life expectancy (LE) had a non-linear effect on income per capita over the 1940–1980 period as this effect was conditional on each country's initial level of life expectancy (LE). Whereas higher LE had an initial statistically significant negative impact on income per capita in countries with LE under 43 years in 1940, the opposite is true in countries with initial life expectancy over 53 years.

[13] present a model in which life expectancy and environmental quality dynamics are jointly determined. They

observed that environmental conditions affect life expectancy. As a result, their model produces a positive correlation between longevity (life expectancy) and environmental quality, both in the long-run and along the transition path. They also show that their results are robust to the introduction of growth dynamics based on physical or human capital accumulation. Similarly, [8] analyzes the relationship between three dimensions (economic, social, and political) of globalization and life expectancy using a panel of 92 countries covering the 1970–2005 period. Using different estimation techniques and sample groupings, they found that economic globalization has a robust positive effect on life expectancy, even when controlling for income, nutritional intake, literacy, number of physicians, and several other factors. The result also holds when the sample is restricted to low-income countries only. In contrast, political and social globalization have no such robust effects.

[5] examines the impacts of mortality decline on long-run growth in a dynastic family, two-sector growth model with social security. A rise in longevity has direct effects on fertility, human capital investment, and growth, as well as indirect effects through increasing unfunded social security contributions. Both the direct and indirect effects depend on the relative strength of the tastes for the number and welfare of children and may have different signs. The net effects of rising longevity on fertility tend to be negative, but positive and significant with human capital investment and growth.
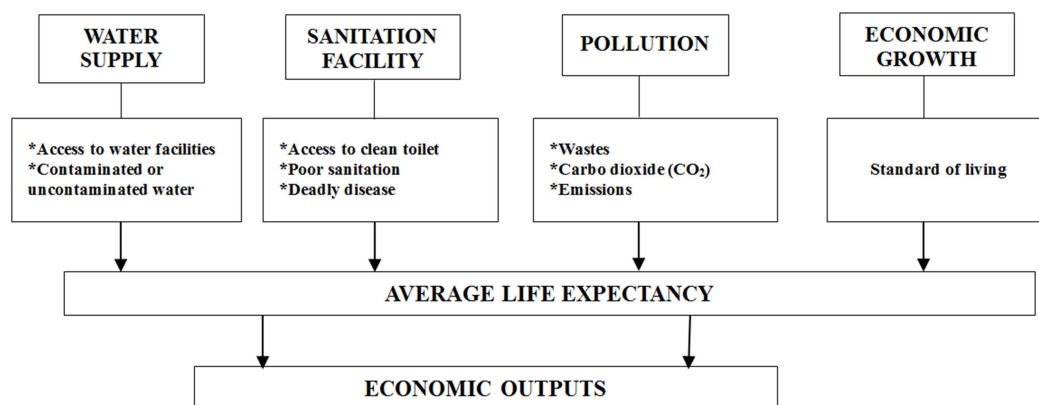
In a developing country, several attempts have been made in the empirical literature to investigate this issue. For example, [8] employed VAR and VECM frameworks to examined the socio-economic determinants of life expectancy in Nigeria using data from 1980-2011. The socio-economic features were proxy by secondary school enrolment, government expenditure on health, per capita income, unemployment rate and the naira foreign exchange rate. It was found that, the conventional socio-economic variables such as per capita income, education and government expenditure on health considered to be highly effective in determining life expectancy of developing countries are not significant in the case of Nigeria.

On the other hand, [6] examine the socio-economic determinants of life expectancy for 91 developing countries using multiple regression and probit regression. Most of explanatory variables turned out to be statistically insignificant, which imply that relevant socio-economic factors like per capita income, education, health expenditure, and urbanization cannot always be considered to be influential in determining life expectancy in developing countries.

However, the studies of [4] and [6] ignored the important of key determinants of longevity; improved water system accessibility and availability, living standard of citizens (ability to meet basic needs), and improved sanitation facilities (access to toilet facilities and clean environment), and pollution in SSA countries. As improved and availability of water is so paramount to citizens' longevity; because in every day every individual need to drink at least 2.5 litres of clean water for healthy living. Most often, human body system can resist only a few days without water but without food individual can survive a few days more. Similarly, the burning of emission, pollution, fossil fuels and associated release of climate pollutants, are causing significant changes in longevity [14].

2.2. Analytical Framework

Source: Author's Initiative, 2017.

Figure 2. Framework for Health Outcomes.

From figure 2 above, there are important determinants of life expectancy. These key determinants that include; improved water system accessibility and availability, living standard of citizens (ability to meet basic needs), and improved sanitation facilities (access to toilet facilities and clean environment), and pollution could influence life expectancy in SSA countries. For example, improved and availability of water is paramount to citizens' longevity; because in every day every individual need to drink at least 2.5 litres of clean water for healthy living. Often, human body system can resist only a few days without water but without food individual can survive a few days more. However, in many SSA countries, potable water is collected from communal sources which are either unimproved (for example, unprotected springs, rivers, and wells) or improved (e.g protected wells, boreholes and public standpipes) [15].

These sources can also be substantial distances from the households, particularly in rural areas of SSA nations. Hence, clean and improved water supply is expected to improve healthy living of individual's longevity in SSA countries.

Although improving water quality and supply is paramount but shown to have a much lower effect than sanitation (Gundry, 2004). Improving Sanitation Facilities (ISF) in Sub-Saharan Africa (SSA) nations concerned preventing illness through managing the environment and by changing household's behavior to reduce exposure to agents of diseases. Half of populations in developing countries especially in SSA countries do not have access to basic toilet and sanitation facilities [15], this could possibly present a major risk to their health outcomes. In addition, deadly diseases are often attributed to poor sanitation currently kill more children globally than HIV/AIDS, malaria, polio and measles put together. Even diarrhea is the single biggest killer of children in Africa [16]. [17] observes that reducing the burden of sanitation-related diseases-borne by poor people in developing countries remains slow and is holding back progress on all other economic outcomes. Apriorily, sanitation and basic toilets provision are proven to be an essential foundation for better citizens' longevity in SSA countries.

Another factor paramount to citizens' longevity is real Gross Domestic Product (RGDP) which represent the measure for living standard of citizens, and the sustained economic outputs increase often translates to improvement in per-citizen-capita-income. Similarly, quality health outcomes are expected to provide ample opportunities for citizens to actively participate in economic productivities for more economic growth. [7], and [18] also notes that healthy population are pre-condition for more economic growth in SSA countries. Therefore, real economic growth per capita is expected to exert a *positive* influence on life expectancy of citizen and likely long live would promote economic productivity in SSA nations.

In addition, there is clear evidence that human actions, principally the burning of emission, pollution, fossil fuels and associated release of climate pollutants, are causing significant changes in longevity [13]. Pollution is a factor that can increase the frequency and severity of health challenges, that is probability of ill health or instantiate it [19]. The highest health risk is for sickness to result in death known as morbidity. Pollution might accentuate health risks and morbidity rate, which has also been identified as a leading human and environmental crisis of the 21st century. A-priorily, clean air and very limited emission are proven to be an essential foundation for better citizens' long live.

The analytical structure (as presented in figure 2) is therefore, in the spirit of [20], and [21]; where citizens' longevity is determined by various factors [20]; and on the other hand, determines human capital [21]. Following Grossman model [20] that long living (LE) are importantly influenced by vector of various factors (X). Therefore,

$$LE = f(X) \qquad (1)$$

where LE represents life expectancy of SSA citizens; X the

vectors of exogenous determinants of longevity (improved water system accessibility and availability; living standard of citizens – the ability to meet basic needs; and improved sanitation facilities – access to toilet facilities and clean environment; and pollution). Thus,

$$LE_{it} = f(IWS_{it}, ISF_{it}, POL_{it}, EG_{it}) \qquad (2)$$

where subscript i represents sample countries in SSA, and t the time periods (from 2000 to 2015).

2.3. Model Specification and Data Sources

The model adapted for this study is predicated on Grossman model and specified following the exposition of [3]. However, the model differs from the aforementioned in that this study account for the role of water supply and its quality (IWS), living standard and citizens' ability to meet basic needs (EG); sanitation, access to toilet facilities and clean environment (ISF); and pollution (POL). In contrast, [3] consider pollution as the only determinant of life expectancy (LE), and infant mortality rate (IMR) as the only dependent variable. Thus, the model for this study is specified as:

$$LE_{it} = \alpha_0 + \beta_1 IWS_{it} + \beta_2 ISF_{it} + \beta_3 POL_{it} + \beta_4 EG_{it} + \mu \quad (3)$$

where LE_{it} is life expectancy. For LE_{it}, the study would rely on *life expectancy at birth total* (LE^T). The life expectancy at birth (LE^T) is the average age a hypothetical birth cohort will reach if it experienced the mortality conditions of the society at a given point in time. α the regional/country-specific effect, β_1, …, β_4 are coefficients of explanatory variables, and μ the disturbance terms. The sources of data for this study were from the World Development Indicators [1] and the study covers a period of 2000 to 2015. The study considered eight SSA (*Angola, Cameroon, Chad, Cote d'Ivoire, Equatorial Guinea, Gabon, Nigeria and Congo Republic*).

3. Results and Discussion

3.1. General Descriptive Results

The descriptive statistics as presented in Table 3 (see appendix) provides information about the means and standard deviations of variables used. The minimum value of LE suggest that average life expectancy was as low as 45 years old in SSA nations. For example, the average life expectancy in Cote d'Ivoire is merely 51 years old in 2015. Table 4 (see appendix) reveal correlation matrix for the variables; some with high correlation and some with low correlation. For example, there is high positive correlation between improved water supply (IWS) and average life expectancy (LE).

3.2. Panel Regression Results

The fixed effects regression result of life expectancy (LE) in SSA countries is presented in Table 1. the estimation results indicated supportive evidence that citizens' health outcomes in SSA nations is dependent on water supply and

its quality (IWS), living standard and citizens' ability to meet basic needs (EG); sanitation, access to toilet facilities and clean environment (ISF); and pollution (POL). As can be observed in Table 1 in the fixed effects regression, there is a clear relationship between average life expectancy (LE), water supply and its quality (IWS), sanitation, access to toilet facilities and clean environment (ISF); and pollution (POL).

Table 1. *Fixed Effects Results.*

Variable	Coefficient	t-statistics
Constant	15.2881*** (3.4362)	4.45
IWS	0.5113*** (0.0501)	10.20
ISF	0.2131*** (0.5337)	3.99
POL	-0.0374*** (0.0154)	-2.42
EG	0.0001* (0.0000)	1.70
Adj. R^2	0.6388	
Nos of obs	128	
Prob.	0.0000	

Notes: 1. ***significance at 1%; **significance at 5%; *significance at 10%.
2. Robust standard errors are reported in parentheses.
Source: Author's computation using Stata 13.

As revealed by Table 1 above, the signs of the coefficients of IWS, ISF, POL and EG confirm the study a-priori expectation. The coefficients of IWS, ISF, POL, and EG (0.5113, 0.2131, -0.0374, and 0.0001) were all statistically significant at 1 per cent level. The pollution (POL) results were consistent with the results obtained by [22] that temporal variation in ecology of diseases increases as pollution rises which resulted to high IMR. In a similar vein, [3] found *positive* relationship between life expectancy and GDP per capita in 148 nations sampled. The result of the random effects in table 2 supported the fixed effects regression result with a slight difference in magnitude. All the signs of the coefficients of IWS, ISF, POL and EG also confirm the study a-priori expectation. The coefficients of IWS, ISF, and EG (0.4133, 0.1589, and 0.00015) in table 2 were all statistically significant at 1 per cent level.

Table 2. *Random Effects Results.*

Variable	Coefficient	t-statistics
Constant	22.0090*** (3.3790)	6.5
IWS	0.4133*** (0.4354)	9.49
ISF	0.1589*** (0.3717)	4.27
POL	-0.0207 (0.0152)	-1.36
EG	0.00015*** (0.00053)	2.84
Adj. R^2	0.6286	
Wald chi 2	167.67	
Prob.	0.0000	

Notes: 1. ***significance at 1%; **significance at 5%; *significance at 10%.
2. Robust standard errors are reported in parentheses.
Source: Author's computation using Stata 13.

In general, the Hausman specification test is used to test for the difference in these two models (fixed and random effect). For model 1, the calculated Hausman statistic (as presented in table 5 in appendix) and distributed chi-square are 36.63 and 0.0000 respectively. These reveals that the p-values<0.05 (5% level), therefore it is appropriate to interprets the random effect models. Most often pooling this cross-country data yields

efficient and consistent estimates if the restrictions imposed are through. In our model, the assumption of slope homogeneity does not hold given that the true model is heterogeneous. This may explain the inconsistency of the PMG. This is reinforced by the Hausman test carried out.

From random effect regression results (see Table 2) suggest that policy efforts that emphasizes on improving water supply and its quality (IWS); sanitation, access to toilet facilities and clean environment (ISF); and improving the living standard and citizens' ability to meet basic needs (EG) are key to higher life expectancy at birth (LE) of citizens in Angola, Cameroon, Chad, Cote d'Ivoire, Equatorial Guinea, Gabon, Nigeria and Congo Republic; because all of these determinants were positive and highly significant with LE. Although increased pollution is *negatively* related to LE but it is not significant probably because most of these countries are still at the early stage of oil exploration.

4. Conclusion

4.1. Limitations of the Study

The recent available time series data from a wide range of emerging nations gave the unique opportunity to explore the major factors associated with life expectancy in SSA countries. However, certain constrained remained and findings should be interpreted with great caution. One, the variables included in the study were still limited and there are some important variables due to data availability are missing in this study. For example, health system characteristics, such as the actual numbers of health providers, their efficiency, the degree of private provision of the services, and health corruption were not included in the study due to mainly lack of adequate time series data. Two, the panel is only for 17 years and hence the long-run impact could not be identified. Lastly, data quality varied by country, some nations may have good data reporting systems while others may rely on estimation to fill in data gaps. The methods used in computing life expectancy are usually country-specific.

4.2. Summary and Policy Implications

The study investigated the major determinants of longevity from recent 2000 to 2015 in Angola, Cameroon, Chad, Cote d'Ivoire, Equatorial Guinea, Gabon, Nigeria and Congo Republic using panel model technique. The results suggest that clean drinkable water; sanitation, and clean environment; and improved living standard were key to higher life expectancy at birth of citizens in these nations. The findings therefore call for effective policy to be directed at providing water and sanitation facilities, and reducing pollution to improve healthy living. Governments efforts should also be directed towards enhancing citizens' welfare. Finally, it is worth mentioning that the current study contributes to existing literature on the major determinants of longevity in SSA nations at the macro level, it also provides essential policy directions on these key determinants; however, completing this study with details analysis of these

determinants (probably at micro level analysis) will be important for the purposes of effective policy making.

Appendix

Table 3. Descriptive Statistics Table.

Variable	Observations	Mean	Standard Dev.	Minimum	Maximum
LE	128	52.9	4.7	45.2	64.9
IWS	128	64.3	15.5	44.7	93.2
ISF	128	31.6	21.3	9.7	80.2
POL	128	63.1	28.7	4.6	100
EG	128	4004.2	5317.7	166.0	2334.7

Source: Author's computation from Stata 13.0.

Table 4. Correlation Matrix Table.

	LE	IWS	ISF	POL	EG
LE	1.00				
IWS	0.54	1.00			
ISF	-0.03	-0.52	1.00		
POL	0.23	0.42	-0.70	1.00	
EG	0.66	0.27	0.11	-0.13	1.00

Source: Author's computation from Stata 13.0.

Table 5. Hausman Test Summary.

	LE
Chi-value	36.63
Prob. value	0.0000

Source: Author's computation from Stata 13.0.

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