Determinants of Life Expectancy in the Central African Republic

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Abstract:

This paper investigates the determinants of life expectancy in the Central African Republic. The study uses economic, social, and environmental factors to estimate a health production function. The study aims to offer suggestions on ways to target life expectancy as a method for increasing economic growth. The results show that the best way to increase longevity in the CAR and solve the mortality crisis are to increase sanitation facilities and regulation, solve the hunger/malnutrition problem, and to reduce the deadly spread of HIV. Aid was determined to be significant in improving the well-being of citizens in the CAR.

JEL Classification: I15, O10, O55
Keywords: Health, Economic Growth, Life Expectancy, Central African Republic

1.0 INTRODUCTION

Life expectancy is one of the major key indicators of population health condition and economic development in a country. In most countries of the world, life expectancy at birth has increased over the last decade. It can fall due to tragedies such as famine, war, disease and poor health. Improvements in areas such as health and welfare can increase life expectancy (Hossain, Golam. 2013). Previous studies have demonstrated that health condition leads to economic growth. The study by Acemoglu & Johnson (2007), demonstrated the relationship between increased life expectancy and improvement in economic growth (measured through Gross Domestic Product (GDP)/capita)), controlling for country fixed effects. The researcher's estimations provide evidence of a positive relationship between life expectancy and GDP per capita, indicating that countries with greater declines in mortality may have a slight increase in GDP per capita.

The relationships of life expectancy on economic growth have been well established at the individual level in earlier research. From a theoretical perception, there are multiple channels through which life expectancy affects economic growth. Firstly, healthier individuals increase their incomes by being more productive, physically more energetic and mentally more robust. A second mechanism for improved economic development is through increases in savings. As people live longer, they will tend to invest more in their retirement. For example, a 10-year increase in longevity is shown to lead to a 4.5% rise in savings (Bloom, Canning, Sevilla, 2004). Thirdly, the improved health status of the people can lead to increased economic growth through increase in education levels. Healthier people tend to invest more in their skills in order to earn higher wages than less healthy people. In addition, a healthier child can attend school, learn more and have higher cognition.

Not only does increased health, resulting in increased life expectancy, expand growth domestically, but it also impacts international relations. Life expectancy, as the strongest indicator of healthiness of a population, is a proxy for human well-being. The World Health Organization's Report of the Commission on Macroeconomics and Health asserts: ''a healthy workforce is important when attracting foreign direct investment (FDI)'' (Commission on Macroeconomics and Health, 2001). Many international agencies have made similar statements regarding the effect of health on FDI inflows. Such claims have bolstered the position of health

on the global development agenda. If health increases FDI inflows in low income countries, then targeting life expectancy could be utilized as a strategy to increase economic growth. Therefore, developing nations interested in increasing long-term economic growth, should also be interested in increasing life expectancy in the country. The Central African Republic is considered low income, thus these assumptions are applicable and relevant to the country.

One of the oldest debates involving economic development in low-income nations is the effectiveness of foreign aid in reducing poverty. This debate has continued for over 50 years and is still just as heavily argued as it was when it started (McGillivray et al. 2006). In spite of all that has been written, both academics and policy makers continue to disagree about the merits of overseas aid programs as a means of overcoming the impoverishment of many countries around the world and alleviating the struggles of millions of people. This lack of consensus is due largely to the contradicting results of previous empirical studies which have failed to produce robust evidence that may resolve the issue one way or the other. Proponents of foreign aid, whilst recognizing its limitations, contend that it has done much to promote growth and raise living standards, and that the outcome for many countries would have been a great deal worse without it (Sachs, 2005). It is further argued that the reason why aid programs may have failed on occasions is not that they lacked potential to improve economic performance, but rather that they were simply insufficient. This view is encapsulated in the big push approach to economic development - that is, the proposal to inject low-income countries with substantial amounts of funds in order to enable them to escape from the poverty trap equilibrium into which they seem to have fallen. Critics of this approach claim that it is misguided, as there is no evidence to suggest that foreign aid has been instrumental in fostering growth and development. On the contrary, it is argued that three decades of overseas assistance have done little or nothing to alleviate poverty, but have merely encouraged corruption and helped to keep bad governments in power (Easterly, 2006a).

Four mortality studies conducted by Médecins Sans Frontières (MSF) in the past 18 months revealed that crude mortality rates in some regions of the Central African Republic are at three times the emergency threshold level, which is considered a humanitarian crisis. The Central African Republic has the second lowest life expectancy in the world at 52 years which is ten

years behind the low-income country life expectancy average of 62 years. As of late September, in 2018, almost 643,000 people were displaced across CAR, and over 573,000 had sought refuge in neighboring countries. Additionally, the country ranks 188 out of 189 countries on the UN's Human Development Index, a composite indicator measuring life expectancy, income and education. Clearly, the CAR is in a mortality crisis that the world is neglecting to acknowledge.

This paper attempts to evaluate the overall effectiveness of foreign aid in terms of its historical impact on life expectancy in the Central African Republic. If life expectancy is the best measurement of well-being, then the relationship between international assistance and life expectancy can be used to determine the success or failure of international aide. Is it helping the people of the Central African Republic at all? If it is determined to not be effective, is there a way that international assistance can be better directed, for example, directly funding private healthcare or improving sanitation services? This paper will attempt to understand the relationship between the two variables and to make suggestions on future aid programs.

This study will conduct an empirical analysis of the determinants of life expectancy in the Central African Republic from 1985 to 2015. Life expectancy, as the strongest indicator of health of a population, is a robust proxy for human welfare. Moreover, studies suggest that increased life expectancy leads to long-term economic growth. This may be due in part to the positive relationship between life expectancy and foreign direct investment. A 2006 study, "The effect of population health on foreign direct investment inflows to low- and middle-income countries" (Alsan, Bloom, Canning, 2006) concluded that "raising life expectancy by one year increases gross Foreign Direct Investment (FDI) inflows by nine percent (9%), after controlling for other relevant variables." These findings are consistent with the popular view that health is an integral component of human capital for developing countries. A better understanding of what factors are important in determining life expectancy could in-turn be targeted as factors promoting economic growth. The objective of this study is to use linear regression to conclude what variables contribute significantly to life expectancy in the Central African Republic, and to determine how international assistance can be better directed in order to increase African life expectancy, as it is a proxy for human well-being and a path to economic growth. Studies such as Blackburn and Forgues-Puccio (2011) question whether or not international assistance is a waste

of capital, only aiding in corruption, or if it actually succeeds in assisting the receiving nations' population. If life expectancy is the best measurement of well-being, then the relationship between international assistance and life expectancy could be used to determine the success or failure of international aide.

The approach of this study is important to other researchers because it may conclude suggestions on the composition, methodology, or direction of future research regarding life expectancy. Additionally, this study could propose ways to direct international assistance to best guide developing nations to improved life expectancies and increased economic growth. Many studies have been done in similar regards, but usually aid effectiveness is examined separately from determinants of life expectancy. Typically, aid is compared with economic growth, but never simultaneously accounts for other factors. It is important to examine multiple factors of life expectancy in combination with international aid in order to determine which factors are more effective in increasing life expectancy. Not only is it crucial for developed nations to direct international assistance in a way that is not profligate of resources, but there is arguably a moral obligation to increase the well-being of all human life, including those people of underdeveloped nations whom are struggling economically, such as in the Central African Republic.

2.0 TRENDS

Overall, since the early 2000's, life expectancy has increased. The world average is up to 72.035 years from the estimated 67.65-year life expectancy of 2000. Image 1 shows that this is due to the decline in late-life mortality. Image 2 shows that life expectancy has been steadily increasing overall, with Africa falling behind. These images also indicate the expected trends of life expectancy to keep rising over the next few decades.

Image 1

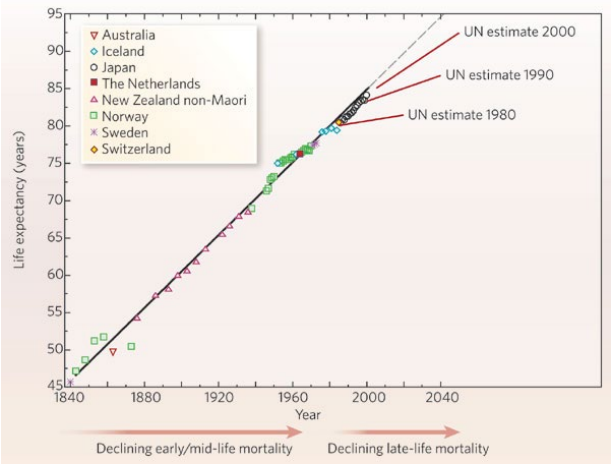
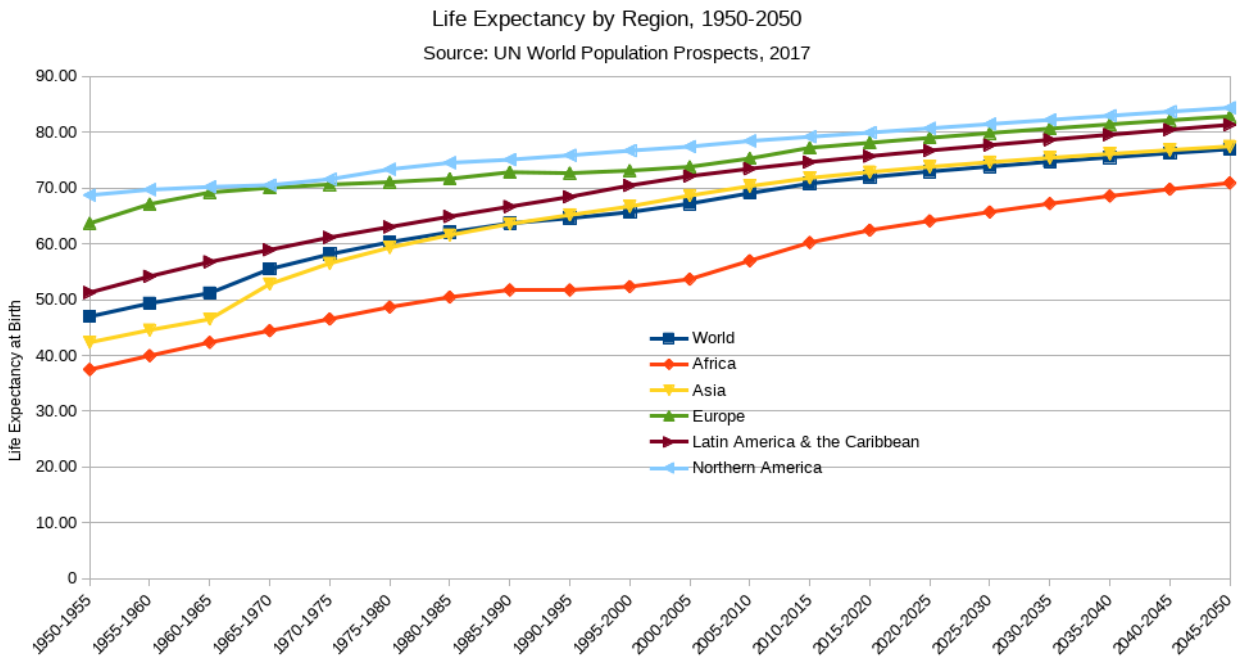


Image 2



3.0 LITERATURE REVIEW

While typically assumed strictly exogenous for the purpose of policy analysis, it has been argued that life expectancy (or more broadly "health") is predetermined by behavioral and policy variables in what can be loosely described as a production function for health. Estimating this function is the goal of this study. Auster, Leveson, and Sarachek (1969) were the first economists to study a population production function for health: a regression of state-level mortality rates on

medical care and environmental variables. If societal health can be measured as life expectancy or mortality rates, what are the various socioeconomic factors that increase or decrease it? Which of these factors produces the largest health benefits to society? Many macroeconomic studies show that several factors contribute to overall health status. Most of these have used aggregate data from the member countries of the OECD (Organization for Economic Cooperation and Development) to explain cross-country life expectancies. While the empirical results are mixed, the general consensus is that population life expectancy is a function of environmental measures, lifestyle measures, and health care measures (Shaw, Horrace, Vogel, 2005). These factors include socioeconomic development, education, culture, environment, health expenditures, urbanization, gender and life style. This study uses a modified version of a model adapted from Bayati et al. 2013.

Ultimately, the goal of this study is to predict the production function for health as measured by life expectancy. Therefore, the primary model was characterized as: H= F (E,S,En). Health status (H) was determined by economic (E), social (S), and environmental (En) factors. Different variables have been used to explain health status. Education is an important factor that determines health in several ways (Kabir 2008). People with high education are more likely to have better jobs, higher incomes, and lower risky behaviors. Food quality and quantity are central to health promotion. Shortage of food and excess intake both contribute to several health problems. Food has been considered in some studies as an input of the health production function. Health expenditure, as representative of resources allocated to health care, shows the access of people to health care production facilities. Previously, it has been considered for explaining the health status of the society (Heijink et al. 2010) but the relationship between expenditures and life expectancy is highly debated. Urbanization is another determinant of health which can have both positive (increasing access to medical centers and information) and negative (pollution) impacts on the overall health. Other factors such as pharmaceutical expenditures, life style, pollution, income inequality, and crime rate have been mentioned as determinants of health.

This study extends previous literature in two ways. First, it provides a better understanding of the determinants of health in a specific country, instead of grouping all low income countries

together. Second, the current study uses time series data, which provides results with less bias and better estimation and normality. It will allow a lengthier time period in order to show more trends. The current study attempts to understand the variables used in past research to analyze the ways in which life expectancy is influenced most. This study focuses on the Central African Republic, a low income country, which are proven to be impacted differently than developed nations in past studies. In a globalizing economy it is important to understand and maintain productive and efficient human capital in order to keep longer term growth alive. A major factor contributing to the development and health of low-income nations is that of international foreign aid. This study will attempt to use the impact of aid on life expectancy as a clue into whether or not foreign aid is successful in improving the lives of the people in these countries. Many studies have been done in similar regards, but usually aid effectiveness is looked at separately from the determinants of life expectancy. Typically, aid is compared with economic growth or life expectancy in general, but never takes into account other factors. It is important to examine multiple factors of life expectancy and international aid so that we can determine which factors are more effective in increasing life expectancy. This will allow estimation of the influence of many factors including aid on life expectancy, in order to suggest future ways of directing international assistance or domestic attention to increase well-being and economic growth.

4.0 DATA AND EMPIRICAL METHODOLOGY

4.1 Data

This study uses time series data from 1985 to 2015. Data are limited for the Central African Republic, but these 30 years have consistent data. Data were obtained from the World Bank website for World Development Indicators. Summary statistics for the data are provided in Table 1.

TABLE 1: SUMMARY STATISTICS

Variable	Observations	Mean	Std. Dev.	Min	Max
LE	30	46.83918	2.910883	43.718	52.171
HE	30	31.20268	5.231828	22.29911	39.86532
FD	30	42.08235	9.141611	32	61.8
SAN	30	21.13357	3.720868	15.01926	26.98752
Aid	30	18.9991	0.6470815	17.91202	20.10212
HIV	30	5.923529	1.673144	4.1	9.3
EDU	30	1.47498	0.3701728	1.056461	2.61265

4.2 Empirical Model

This study uses a modified version of a model adapted from Bayati et al. (2013). This study adds net official development assistance and official aid received, as well as prevalence of HIV.
The model will be written as follows:

$$L\,LE_{it} = \beta_{0it} + \beta_1 HEit + \beta_2 FD_{it} + \beta_3 SAN_{it} + \beta_4 lAID_{it} + \beta_5 EDU_{it} + \beta_6 HIV_{it} + u_{it}$$

LE is Life expectancy at birth, total (in years). It indicates the number of years a newborn would live if historical patterns of mortality at the time of birth were to remain consistent throughout the lifespan. Life expectancy measures health and mortality. It is recorded annually. Limitations and exceptions: Annual data from United Nations Population Division's World Population Prospects include data from 5 year periods. Therefore, they may not reflect real events as much as observed data. (World Development Indicators).

The independent variables consist of six variables obtained from World Development Indicators. Appendix A and B provide acronyms, descriptions, and expected signs for the variables.

5.0 EMPIRICAL RESULTS

The empirical estimation results are presented in Table 2.

TABLE 2: REGRESSION OUTPUT

Variable	Coefficient	P-Value
Constant	4.241	---------
HE	-0.036	0.242
FD	-0.045	0.008
SAN	0.945	0.000
AID	0.898	0.023
EDU	0.023	0.938
HIV	-0.800	0.019

Overall, the adjusted r-squared value for this regression was 0.68, indicating that the independent variables accounted for 68% of the variation in the dependent variable, life expectancy. The p-value was 0.000 for the study, proving that these variables are statistically significant together in determining life expectancy. The variables determined to be significant were FD, SAN, AID, and HIV. The variables that were insignificant were HE and EDU.

Health expenditures has typically been known to show a positive relationship with life expectancy. This intuitively makes sense that as the government spends money and allocates

resources to health care, life expectancy should increase. Some studies however, have resulted in negative relationships. It is believed that the high expenditures on health in low income areas are related to high user fee; thus, the positive effects of health facility provision due to increment expending in health is offset by reduction of personal financial access. Thus, the negative result in this study is exemplified as it analyzes the Central African Republic, a low income country. In addition, population may be increasing faster than GDP, so even though the CAR is allocating more of their resources towards health expenditures, it proportionally is decreasing compared to population. As health expenditures increase by 1% of GDP, life expectancy decreases by 0.036 years. However, since the variable is insignificant, it is not an important factor in determining life expectancy in the CAR. This could be due to the lack of substantial healthcare services.

EDU was also determined to be insignificant, although positive. This shows that higher education expenditures increases life expectancy, however, for the CAR it is not an important factor. Research associates this insignificance with the fact that many children in the CAR do not enroll in school, therefore, it doesn't matter how much money the government puts towards education.

The significant variables of interest as mentioned, were FD, SAN, AID, and HIV.
To begin with FD, the population percentage that is considered malnourished, as this variable increases by 1, life expectancy decreases by 0.045 significantly. This shows that malnourishment is an important crisis in the CAR and that solving the hunger problem would be very significant in improving the lives of the citizens.

Percent of population using sanitation facilities is also significant. As this number increases by 1, life expectancy increases by 0.945. This is an important variable especially because summary statistics showed that on average, only about 20% of people have access to basic level sanitation services. Sanitation facilities reduce public defecation, which improves air quality, water quality, and so on. Therefore, this is something that is important to keep in mind for the CAR.

AID, the heavily debated variable, was significant. As aid increases by 1%, life expectancy increases by 0.898 years. This is crucial because it proves that foreign aid is increasing the well-being of the people in the CAR contrary to debate.

Finally, HIV is a significant variable. The CAR has extremely high rates of HIV. This study shows that as HIV increases by 1, life expectancy decreases by 0.8. HIV is a huge problem in the CAR that needs to be addressed in order to improve the longevity of people.

6.0 CONCLUSION

There are policy implications of this study based on the variables found significant versus insignificant. First, sanitation facilities need to be increased and moderated more heavily. Sanitation was a significant positive variable, but on average, only 21% have access to basic level services. The food deficit in the Central African Republic contributes to the undernourishment of citizens. Thus, the CAR needs to increase their food imports. This could be done through international assistance as well. But 41% of people considered malnourished is astronomical. Next, HIV contributes significantly toward the high mortality rates in the CAR. Thus, there needs to be increased education and preventative measures regarding the subject. After debate, Aid is significant in determining life expectancy in the CAR, thus aid should not be halted or deemed unnecessary. Developed nations can help solve the mortality crisis in the CAR through the ways mentioned. Government health expenditures are insignificant, most likely due to the poor quality of health services in the CAR. Education expenditures are also insignificant Thus, Government capital should be directed toward sanitation facilities, food resources, and HIV control, rather than health or education.

To conclude, the Central African Republic is in a mortality crisis that the world is neglecting to solve. Foreign Aid is significant in increasing life expectancy; thus, developed nations should be trying to help. Directing funds towards HIV control, sanitation facilities, and food resources, could help resolve the issue.

This study is not without limitations. Unavailability of long-term data for relevant indicators is a particular problem. Because the CAR is a low income country, possible misclassification of variables and their discrepancies in reporting could be a limitation. The study estimated a health production function for the CAR only, thus the results and policy implications are not applicable to any other country. Finally, the study demonstrates correlation not causation. There is a possibility of reverse causality.

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APPENDIX

Appendix A

LE: Life expectancy at birth, total (in years). It indicates the number of years a newborn would live if historical patterns of mortality at the time of birth were to remain consistent throughout the lifespan. Life expectancy measures health and mortality. It is recorded annually. Limitations and exceptions: Annual data from United Nations Population Division's World Population Prospects include data from 5 year periods. Therefore, they may not reflect real events as much as observed data. (World Development Indicators).

HE: Current expenditures on health per capita expressed in international dollars at purchasing power parity (PPP). Strengthening health financing is one objective of Sustainable Development Goal 3 (SDG target 3.c). The levels and trends of health expenditure data identify key issues such as weaknesses and strengths and areas that need investment, for instance additional health facilities, better health information systems, or better trained human resources. Health financing is also critical for reaching universal health coverage (UHC) defined as all people obtaining the quality health services they need without suffering financial hardship (SDG 3.8). The data on out-of-pocket spending is a key indicator with regard to financial protection and hence of progress towards UHC. (World Development Indicators)

FD: Prevalence of undernourishment (% of population). Population below minimum level of dietary energy consumption (also referred to as prevalence of undernourishment) shows the percentage of the population whose food intake is insufficient to meet dietary energy requirements continuously. Data showing as 5 may signify a prevalence of undernourishment below 5%. Limitations and exceptions: First, food insecurity exists even where food availability is not a problem because of inadequate access of poor households to food. Second, food insecurity is an individual or household phenomenon, and the average food available to each person, even corrected for possible effects of low income, is not a good predictor of food insecurity among the population. And third, nutrition security is determined not only by food security but also by the quality of care of mothers and children and the quality of the household's health environment (Smith and Haddad 2000). (World Development Indicators). Expected relationship: negative.

SAN: People using at least basic sanitation services (% of population). The percentage of people using at least basic sanitation services, that is, improved sanitation facilities that are not shared with other households. This indicator encompasses both people using basic sanitation services as well as those using safely managed sanitation services. Improved sanitation facilities include flush/pour flush to piped sewer systems, septic tanks or pit latrines; ventilated improved pit latrines, compositing toilets or pit latrines with slabs. Limitations and exceptions: National, regional and income group estimates are made when data are available for at least 50 percent of the population. (World Development Indicators). Expected relationship: positive.

AID: Net official development assistance and official aid received (constant 2015 US$). Net official development assistance (ODA) consists of disbursements of loans made on concessional terms (net of repayments of principal) and grants by official agencies of the members of the Development Assistance Committee (DAC), by multilateral institutions, and by non-DAC countries to promote economic development and welfare in countries and territories in the DAC list of ODA recipients. It includes loans with a grant element of at least 25 percent (calculated at a rate of discount of 10 percent). Net official aid refers to aid flows (net of repayments) from official donors to countries and territories in part II of the DAC list of recipients: more advanced countries of Central and Eastern Europe, the countries of the former Soviet Union, and certain advanced developing countries and territories. Official aid is provided under terms and conditions similar to those for ODA. Part II of the DAC List was abolished in 2005. The collection of data on official aid and other resource flows to Part II countries ended with 2004 data. Data are in constant 2015 U.S. dollars. Limitations and exceptions: Some low income countries included in this study may not be considered an official ODA recipient. Conversely, aid may be received from a country who is not considered an official DAC country. (World Development Indicators). Expected relationship: positive.

EDU: Literacy rate, adult total (% of people ages 15 and above). Adult literacy rate is the percentage of people ages 15 and above who can both read and write with understanding a short simple statement about their everyday life. Literacy rate is an outcome indicator to evaluate educational attainment. This data can predict the quality of future labor force and can be used in ensuring policies for life skills for men and women. It can be also used as a proxy instrument to

see the effectiveness of education system; a high literacy rate suggests the capacity of an education system to provide a large population with opportunities to acquire literacy skills. The accumulated achievement of education is fundamental for further intellectual growth and social and economic development, although it doesn't necessarily ensure the quality of education. Limitations and exceptions: In practice, literacy is difficult to measure. Estimating literacy rates requires census or survey measurements under controlled conditions. Many countries report the number of literate people from self-reported data. Some use educational attainment data as a proxy but apply different lengths of school attendance or levels of completion. There is a trend among recent national and international surveys toward using a direct reading test of literacy skills. Because definitions and methods of data collection differ across countries, data should be used cautiously. (World Development Indicators). Expected relationship: positive.

HIV: Prevalence of HIV, total (% of population ages 15-49). Prevalence of HIV refers to the percentage of people ages 15-49 who are infected with HIV. Limitations and exceptions: The limited availability of data on health status is a major constraint in assessing the health situation in developing countries. Surveillance data are lacking for many major public health concerns. Estimates of prevalence and incidence are available for some diseases but are often unreliable and incomplete. National health authorities differ widely in capacity and willingness to collect or report information. (World Development Indicators). Expected relationship: negative.

Appendix B – Variable Description

Variable	Description	Expected Sign
LE	Average number of years that a newborn could expect to live, if it were to pass through life subject to age-specific death rates.	-----
HE	Current health expenditure per capita, PPP (current international $)	Positive (+)

FD	Prevalence of undernourishment (% of population)	Negative (-)
SAN	People using at least basic sanitation services (% of population)	Positive (+)
AID	Net official development assistance and official aid received per capita, PPP (constant 2016 US$)	Positive (+)
EDU	Government expenditure on education, total (% of GDP)	Positive (+)
HIV	Prevalence of HIV, total (% of population ages 15-49)	Negative (-)